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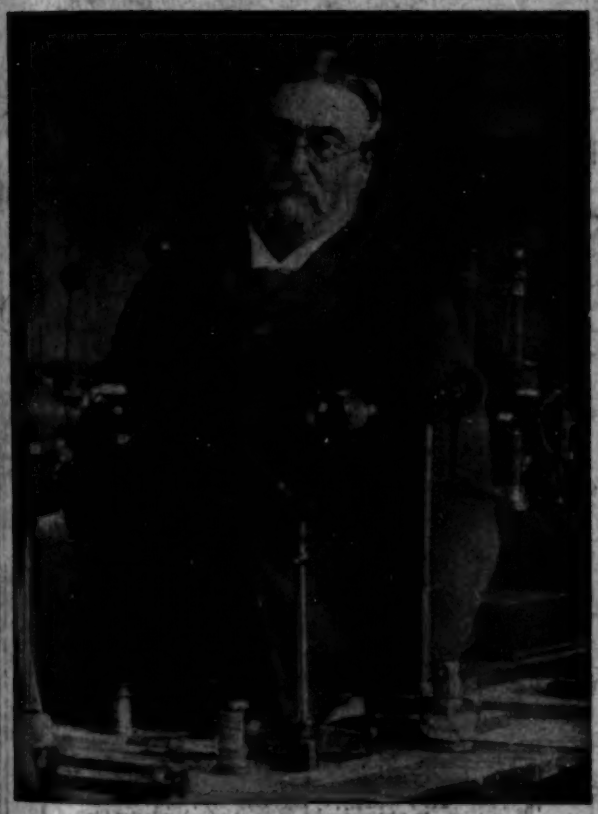

THE PRESIDENT OF THE BRITISH ASSOCIATION, 1903.

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A MONTHLY MAGAZINE AND REVIEW FOR THE SCHOOL-ROOM AND THE STUDY

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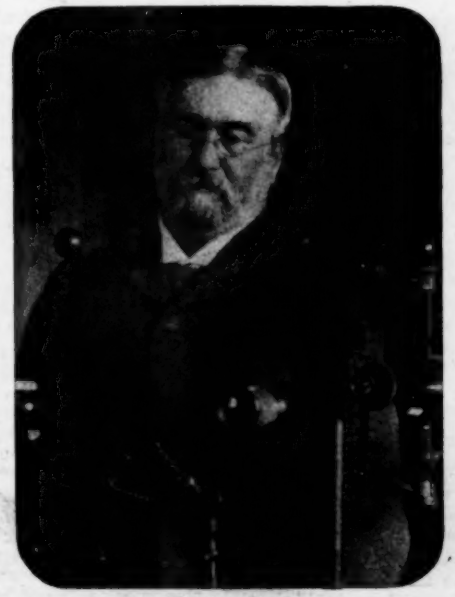
THE BRITISH ASSOCIATION AT SOUTHPORT.

THE PRESIDENT: SIR NORMAN LOCKYER.

NEVER since its inception in the early twenties of the nineteenth century has the British Association for the Advancement of Science deserved more attention at the hands of teachers than at present, when every one of its sections has its educational outlook, and when educational science has a section all to itself, the importance of which may be gauged from the fact that it is presided over year by year by the Secretary of the Board of Education. It was meet, therefore, that an official of the N.U.T. should watch the proceedings of the Southport meeting which opened on Wednesday, September 9, and continued its deliberations until the following Wednesday. It is to be regretted that the N.U.T. should not be officially represented in the section, when it is noted how closely concerned are the primary schools and teachers of England with the topics under discussion, which were as follows:—

1. The conditions of health essential to the carrying on of work of instruction in schools. 2. The teaching of natural science in elementary schools. 3. The influence exercised by universities and examining bodies on secondary school curricula, and also of the schools on university requirements. 4. The teaching of botany in schools.



SIR NORMAN LOCKYER.

It seems absurd to discuss the problem of teaching natural science in primary schools without the assistance of the primary practical teacher; but in this country it is so natural to ignore the expert, that even the expert does not always see the humour (and the pathos) of the situation.

However, in the present paper we are more concerned with the president than with the educational section, and here let it be observed that the president is himself a teacher who has come into close contact with primary school teachers and their pupils, if only as Examiner in Physiography for the Board of Education, South Kensington branch; for the president is our old friend Sir Norman Lockyer, whom we have already noticed in the *Practical Teacher* as the maker of physiography.

Born at Rugby on May 17, 1836, Sir Norman was educated privately and on the Continent, and is to be therefore included in the long roll of eminent Englishmen who owe nothing to either Oxford or Cambridge. In 1857 he was appointed to the War Office, and the Army Regulations of 1865 were edited by him as a consequence. In 1870 a royal commission on science sat under the presidency of the Duke of Devonshire, and to this commission Sir Norman Lockyer was appointed secretary. Five years later he was transferred—much to his satisfaction—to the newly-created Science and Art Department. Prior to this—namely, in 1869—he had

been elected a Fellow of the Royal Society, and in 1871 he was chosen as their lecturer at Cambridge. The French Académie des Sciences elected him a correspondent in 1875, and other academic distinctions, too numerous to mention here, have, from time to time, been bestowed on him. But it is as Director of the Solar Physics Observatory at South Kensington that Sir Norman Lockyer is best known. Here, in the midst of his telescopes and cameras, ably assisted by his son, Dr. W. J. Lockyer, the president is engaged in the herculean task of solving the mystery of the composition and constitution of the sun and its fellow suns, which we call stars.

There is nothing imposing about the medley of corrugated iron sheds which house the apparatus got together by Sir Norman Lockyer. But, as the director told us on the occasion of our visit, they answer his purpose as well as more pretentious buildings would do; so that he is not likely to quarrel with his environment if only he is allowed sufficient money wherewith to obtain the necessary instruments for the prosecution of his quest. If anything beyond Sir Norman's accomplishments were needed to justify the existence of the unique astro-physical observatory over which the president presides, it is that the French authorities have just paid us the compliment of imitating us by establishing a similar observatory at Meudon. But the work done at South Kensington more than justifies the existence of the observatory, and what that work is would require more space than we have at our disposal to set out. We may mention, perhaps, the meteoric hypothesis and the attempt to establish a connection between sun-spot periods and Indian famines as two instances from the theoretical and from the practical standpoint, as showing the trend of this work; whilst the following list of publications will give further indication of the scope of the director's activity:—

Elementary Lessons in Astronomy (1870), *The Spectroscope and its Applications* (1873), *Primer of Astronomy* (1874), *Studies in Spectrum Analysis* (1878), *Star Gazing, Past and Present* (1878), *Chemistry of the Sun* (1887), *Movements of the Earth* (1887), *Meteoric Hypothesis* (1890), *Dawn of Astronomy* (1894), *The Sun's Place in Nature* (1897), *Inorganic Evolution* (1900).

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Over and above this work of research, Sir Norman has ably carried on his work as examiner and instructor at South Kensington, in connection with the Science and Art Department; and those who have been fortunate enough to come under his care know how enthusiastic and how cheery a personality the director possesses.

As befitted an organiser and "researcher," Sir Norman in his Southport address advocated the organisation of science and the endowment of research in universities and elsewhere. Moreover, as a business man, he urged the Association to take the matter of organisation into its own hands. That he was right in his contention that the advancement of science is the one prime need in our England of to-day, nobody will seriously deny; and if the outcome of the address be the better provision of means, and the better appreciation of the ends of instruction in science in this country, no one will rejoice more sincerely than the worthy president himself, who will, we hope, live to see many of his clever ideas yet materialised by a people and by a government better versed in science and its capabilities than we have so far experienced in what was once happy, but is now fast becoming happy-go-lucky, England.

THE PRESIDENT'S SPEECH.

The President's speech caused a considerable amount of disappointment among the large and fashionable audience which had assembled to hear it. It has been the general practice for the opening speech to deal with a review of the progress of the particular branch of scientific work to which the president has most particularly devoted himself; but on this occasion the president dealt with the necessity for the State to give more encouragement to the teaching of science, particularly in the higher branches. Like most people who strive for reform, Sir Norman Lockyer allowed himself to indulge in a certain amount of exaggeration in his special pleading. He accused our statesmen of considering political and fiscal problems to be the only matters of importance. He referred to the Report of the Royal Commission on the War in South Africa as showing that those employed in the State service were deficient in brain power and grip of the conditions of the modern world into which science so largely entered. His speech contained one or two inconsistencies; for he showed that "in Britain, as compared with America, apprentices who could pay high premiums were too often preferred to those who were well educated, and the old rule-of-thumb processes to our new developments." But yet he went on to advocate the expenditure of large sums of money on the production of the well-educated man who will have to give way to those who can pay high premiums. It would seem that the first desideratum is the better recognition of those that are equipped, and not the wholesale equipment of those who will meet with no recognition. Despite the hyperbolical way of stating the case, there was much in the president's speech that should commend itself to the Government and lead to prompt action.

OUR SPECIAL CORRESPONDENT'S NOTES.

IN dreary wintry weather the annual gathering of the representatives of British science opened at Southport on the 9th of September. The cordial welcome accorded to them by the Lancashire watering-place met with no echo from the elements, which seemed determined to chill their persons if they could not quench their ardour. The president for the year was the veteran astronomer Sir Norman Lockyer, K.C.B., well known as one of the most brilliant investigators and most daring theorists among astronomers of the day. The subject which he chose for his inaugural address was not, as might have been expected, that in which he had become famous. He followed the example of some of his recent predecessors in letting this severely alone, and he followed up the discourse of Professor Dewar at Belfast by dwelling chiefly on the necessity of cultivating and developing scientific study and research if England's position among the nations is to be maintained. More practical, or perhaps more visionary, than his predecessor, he appealed pointedly to the Government for such an endowment of university work and teaching as should put the country into a position that would compare not unfavourably with Germany and the United States in this particular. Sir Norman's estimate of these requirements will not in all likelihood commend itself to the Chancellor of the Exche-

BRITISH MUSEUM

quer, as he put them down at something over twenty millions of money, for building equipment and endowment, if the country is to hold its own. He laid great stress on the necessity of applying these resources to the cultivation of the scientific spirit and the development of brain power. In somewhat pessimistic mood he called attention to the difference in difficulty between setting money apart for such purposes and applying large sums to the side of national development associated with military and naval establishments. A feasible suggestion with which he concluded was the formation of a guild of all the scientific societies in the empire, and the formation of a scientific national council to assist the Government of the country on educational things of vital importance.

Coal Resources and their Utilisation.

The sectional presidential addresses were of a highly important character, in many particulars being more practical than usual. The discourse given by Professor W. M. Watts in the geological section may particularly be alluded to, dealing, as it did, with one of the most important economic features of the country. At the outset he pointed out that Great Britain now has no monopoly of underground wealth. Other nations are waking up, and day by day we are feeling the competition of their awakening strength. He put before the section three important considerations: first, our mineral wealth is at present unexhausted; second, that of our colonies is as yet almost untouched; third, there are still many uncolonised areas left in the world. Discussing these and the position they led up to, he pointed out that the actual abundance of our coal and iron, and the ease of extracting it, have been an economic danger. There has been waste in exploration, because of ignorance of the structure and position of the coal-yielding rocks; waste in extraction, because of defective appliances, of the working only of the best paying seams and areas, of the water difficulty, and the want of well-kept plans and records of areas worked and unworked; waste in employment, because of the low efficiency of the machinery which turns this energy into work. Taking into account all the waste thus caused, the result has been that the total energy derived from our coal-fields has not been much more than one per cent. of that which the consumed coal actually possessed when *in situ*. Attention is now being given both by engineers and by geologists to minimise this enormous leakage, but still it must give cause for grave apprehension. Further cause for reflection is afforded by the fact that though we have got to know fairly well the extent and the character of our visible coal-fields, so much coal has now been raised, so much wasted in extraction, and so many areas rendered dangerous or impossible to work, that those visible coal-fields are, in many cases, rapidly approaching exhaustion. On the other hand, however, the third consideration presents certain features which are more satisfactory. We have in England still an area of concealed coal-fields, which many authorities hold to be probably as large and as productive as those already explored, and as full of hope for industrial development. Professor Watts appealed for systematic and detailed exploration, guided by scientific principles, and advancing from the known to the unknown.

The "Miracle" of Radium.

The subject which for the moment is stirring the world of chemists and of physicists as deeply as some years ago it was moved by the discovery of argon and the other minimal constituents of the air is the curious element now called radium. It has naturally attracted a good deal of attention in the section devoted to physics, and discussion of its peculiarities has been taken part in by Professors Boys, Dewar, Lodge, and Armstrong, controversy of a highly technical character having taken place between the chemists and the physicists. Professor Boys described a new radium compound, lately discovered by Professor Madame Curie of Paris, as not only a mystery, but a miracle. It seemed to show an everlasting producer of heat, which could scarcely be distinguished from perpetual motion. Sir William Crookes had devised an experiment in which a particle of radium kept a screen bombarded for ever—so it seemed—each collision producing a microscopic flash of light, the dancing and multitude of which realised the existence of atomic tumult. An atom of radium could constantly produce an emanation that was something like a gas, which escaped and carried with it certain properties, and yet the atom remained and retained its weight. The emanation was truly wonderful—it was self-luminous; was condensed by extreme cold and vapourised again; it could be watched as it oozed through stop-cocks or hurried through tubes; but in amount it was so small that it had not yet been weighed. Just as the gases had no chemical properties, so the radium which produced them behaved in some respects in a manner contrary to that of all proper chemicals. It did not lose its power of creating heat at the extreme cold of liquid air, while at the greater degree of cold of liquid hydrogen its activity was found by Professor Dewar to be actually greater.

Cerebral Development of Prehistoric Man.

Professor Johnson Symington, in opening the anthropological section, dwelt upon several problems arising from the variations in the development of the skull and brain, and while pointing out that the crania in our anthropological collections are as numerous, well-preserved, and varied, as the brains are few in number and defective both in their state of preservation and their representative character, he called attention to the fact that craniologists, as a whole, have concentrated their attention mainly on the external contour of the skull, and have paid but little attention to the form of the cranial cavity—a matter that would presumably have a much closer relationship to the brain that filled it than would its mere exterior. This is a matter of considerable interest, because, so far as prehistoric man is concerned, we cannot hope to obtain any direct evidence of the condition of his higher nerve centres, and must depend for an estimate of his cerebral development upon those more or less perfect skulls which have resisted for so many ages the corroding hand of time. The outer surface of the skull presents features which are due to other factors than brain development, such as muscles, jaws, and teeth; while an examination of the cranial cavity not only gives us information as to brain form, but by affording a comparison between the external and the internal surfaces of the skull wall it yields us a valuable clue to the real significance of the external configuration. Professor Symington cautioned his hearers that though the facts that can be ascertained from a study of a series of skulls regarding the size and form of the brain are both interesting and important, there are distinct limits to the knowledge that can be obtained from this source. The absence of the brains belonging to the skulls prevents our gaining valuable information as to racial characters. We know that, as a rule, the brains of the less civilised races are smaller, and the convolutions and fissures simpler, than those of the more cultured nations, but beyond this little has been definitely determined. As the results of investigations in human and comparative anatomy and physiology, we have learned that definite areas of the cerebral cortex are connected with the action of definite groups of muscles, and that the nervous impulses starting from the organs of special sense reach definite cortical fields. But not more than a third of the convoluted surface of the brain has so been marked out, and the remaining two-thirds still form unexplored territory. Do these afford a localisation of special mental and moral qualities or tendencies?

The Floras of the Past.

One of the most striking of the sectional presidential addresses was that given in Section K (Botany) by Mr. Seward, F.R.S., of Cambridge, one of the most prominent palæophytologists of the time. In the brief space of an hour he took his audience over the leading features of the floras of the past, sketching the gradual course of the development of plant life from age to age as told by the traces of the rocks, and pointing out the distribution in space of the most prominent forms of vegetation during those successive periods. It was a great task, and in the hands of many men the effort to deal with such multitudinous detail in so brief a period would have resulted in hopeless confusion. The story as told by the president of the section was, however, clear and lucid,

been elected a Fellow of the Royal Society, and in 1871 he was chosen as their lecturer at Cambridge. The French Académie des Sciences elected him a correspondent in 1875, and other academic distinctions, too numerous to mention here, have, from time to time, been bestowed on him. But it is as Director of the Solar Physics Observatory at South Kensington that Sir Norman Lockyer is best known. Here, in the midst of his telescopes and cameras, ably assisted by his son, Dr. W. J. Lockyer, the president is engaged in the herculean task of solving the mystery of the composition and constitution of the sun and its fellow suns, which we call stars.

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The first paper on "Spectroscopic Observations of the Sun" is in the *Proceedings of the Royal Society*, October 1866; the second in the *Philosophical Transactions*, November 1868. In addition, Sir Norman Lockyer has contributed to the learned societies and publications upwards of 130 papers on the investigations with which his name is inseparably connected:—"Stellar Spectroscopy;" "The Chemistry of the Sun;" "The Spectra of the Gases;" "The Spectra of Meteorites and Nebulæ;" "The Causes which Produce the Phenomena of New Stars;" "Spectrum Observations of New and Rare Gases;" "The Investigation of the Sun's Atmosphere and Sun Spots;" "The Possible Connection between Solar and Terrestrial Phenomena;" and the "Relation of Sun Spots to Earth Magnetism and Earth Weather."

Over and above this work of research, Sir Norman has ably carried on his work as examiner and instructor at South Kensington, in connection with the Science and Art Department; and those who have been fortunate enough to come under his care know how enthusiastic and how cheery a personality the director possesses.

As befitted an organiser and "researcher," Sir Norman in his Southport address advocated the organisation of science and the endowment of research in universities and elsewhere. Moreover, as a business man, he urged the Association to take the matter of organisation into its own hands. That he was right in his contention that the advancement of science is the one prime need in our England of to-day, nobody will seriously deny; and if the outcome of the address be the better provision of means, and the better appreciation of the ends of instruction in science in this country, no one will rejoice more sincerely than the worthy president himself, who will, we hope, live to see many of his clever ideas yet materialised by a people and by a government better versed in science and its capabilities than we have so far experienced in what was once happy, but is now fast becoming happy-go-lucky, England.

THE PRESIDENT'S SPEECH.

The President's speech caused a considerable amount of disappointment among the large and fashionable audience which had assembled to hear it. It has been the general practice for the opening speech to deal with a review of the progress of the particular branch of scientific work to which the president has most particularly devoted himself; but on this occasion the president dealt with the necessity for the State to give more encouragement to the teaching of science, particularly in the higher branches. Like most people who strive for reform, Sir Norman Lockyer allowed himself to indulge in a certain amount of exaggeration in his special pleading. He accused our statesmen of considering political and fiscal problems to be the only matters of importance. He referred to the Report of the Royal Commission on the War in South Africa as showing that those employed in the State service were deficient in brain power and grip of the conditions of the modern world into which science so largely entered. His speech contained one or two inconsistencies; for he showed that "in Britain, as compared with America, apprentices who could pay high premiums were too often preferred to those who were well educated, and the old rule-of-thumb processes to our new developments." But yet he went on to advocate the expenditure of large sums of money on the production of the well-educated man who will have to give way to those who can pay high premiums. It would seem that the first desideratum is the better recognition of those that are equipped, and not the wholesale equipment of those who will meet with no recognition. Despite the hyperbolical way of stating the case, there was much in the president's speech that should commend itself to the Government and lead to prompt action.

OUR SPECIAL CORRESPONDENT'S NOTES.

IN dreary wintry weather the annual gathering of the representatives of British science opened at Southport on the 9th of September. The cordial welcome accorded to them by the Lancashire watering-place met with no echo from the elements, which seemed determined to chill their persons if they could not quench their ardour. The president for the year was the veteran astronomer Sir Norman Lockyer, K.C.B., well known as one of the most brilliant investigators and most daring theorists among astronomers of the day. The subject which he chose for his inaugural address was not, as might have been expected, that in which he had become famous. He followed the example of some of his recent predecessors in letting this severely alone, and he followed up the discourse of Professor Dewar at Belfast by dwelling chiefly on the necessity of cultivating and developing scientific study and research if England's position among the nations is to be maintained. More practical, or perhaps more visionary, than his predecessor, he appealed pointedly to the Government for such an endowment of university work and teaching as should put the country into a position that would compare not unfavourably with Germany and the United States in this particular. Sir Norman's estimate of these requirements will not in all likelihood commend itself to the Chancellor of the Exche-

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quer, as he put them down at something over twenty millions of money, for building equipment and endowment, if the country is to hold its own. He laid great stress on the necessity of applying these resources to the cultivation of the scientific spirit and the development of brain power. In somewhat pessimistic mood he called attention to the difference in difficulty between setting money apart for such purposes and applying large sums to the side of national development associated with military and naval establishments. A feasible suggestion with which he concluded was the formation of a guild of all the scientific societies in the empire, and the formation of a scientific national council to assist the Government of the country on educational things of vital importance.

Coal Resources and their Utilisation.

The sectional presidential addresses were of a highly important character, in many particulars being more practical than usual. The discourse given by Professor W. M. Watts in the geological section may particularly be alluded to, dealing, as it did, with one of the most important economic features of the country. At the outset he pointed out that Great Britain now has no monopoly of underground wealth. Other nations are waking up, and day by day we are feeling the competition of their awakening strength. He put before the section three important considerations: first, our mineral wealth is at present unexhausted; second, that of our colonies is as yet almost untouched; third, there are still many uncolonised areas left in the world. Discussing these and the position they led up to, he pointed out that the actual abundance of our coal and iron, and the ease of extracting it, have been an economic danger. There has been waste in exploration, because of ignorance of the structure and position of the coal-yielding rocks; waste in extraction, because of defective appliances, of the working only of the best paying seams and areas, of the water difficulty, and the want of well-kept plans and records of areas worked and unworked; waste in employment, because of the low efficiency of the machinery which turns this energy into work. Taking into account all the waste thus caused, the result has been that the total energy derived from our coal-fields has not been much more than one per cent. of that which the consumed coal actually possessed when *in situ*. Attention is now being given both by engineers and by geologists to minimise this enormous leakage, but still it must give cause for grave apprehension. Further cause for reflection is afforded by the fact that though we have got to know fairly well the extent and the character of our visible coal-fields, so much coal has now been raised, so much wasted in extraction, and so many areas rendered dangerous or impossible to work, that those visible coal-fields are, in many cases, rapidly approaching exhaustion. On the other hand, however, the third consideration presents certain features which are more satisfactory. We have in England still an area of concealed coal-fields, which many authorities hold to be probably as large and as productive as those already explored, and as full of hope for industrial development. Professor Watts appealed for systematic and detailed exploration, guided by scientific principles, and advancing from the known to the unknown.

The "Miracle" of Radium.

The subject which for the moment is stirring the world of chemists and of physicists as deeply as some years ago it was moved by the discovery of argon and the other minimal constituents of the air is the curious element now called radium. It has naturally attracted a good deal of attention in the section devoted to physics, and discussion of its peculiarities has been taken part in by Professors Boys, Dewar, Lodge, and Armstrong, controversy of a highly technical character having taken place between the chemists and the physicists. Professor Boys described a new radium compound, lately discovered by Professor Madame Curie of Paris, as not only a mystery, but a miracle. It seemed to show an everlasting producer of heat, which could scarcely be distinguished from perpetual motion. Sir William Crookes had devised an experiment in which a particle of radium kept a screen bombarded for ever—so it seemed—each collision producing a microscopic flash of light, the dancing and multitude of which realised the existence of atomic tumult. An atom of radium could constantly produce an emanation that was something like a gas, which escaped and carried with it certain properties, and yet the atom remained and retained its weight. The emanation was truly wonderful—it was self-luminous; was condensed by extreme cold and vapourised again; it could be watched as it oozed through stopcocks or hurried through tubes; but in amount it was so small that it had not yet been weighed. Just as the gases had no chemical properties, so the radium which produced them behaved in some respects in a manner contrary to that of all proper chemicals. It did not lose its power of creating heat at the extreme cold of liquid air, while at the greater degree of cold of liquid hydrogen its activity was found by Professor Dewar to be actually greater.

Cerebral Development of Prehistoric Man.

Professor Johnson Symington, in opening the anthropological section, dwelt upon several problems arising from the variations in the development of the skull and brain, and while pointing out that the crania in our anthropological collections are as numerous, well-preserved, and varied, as the brains are few in number and defective both in their state of preservation and their representative character, he called attention to the fact that craniologists, as a whole, have concentrated their attention mainly on the external contour of the skull, and have paid but little attention to the form of the cranial cavity—a matter that would presumably have a much closer relationship to the brain that filled it than would its mere exterior. This is a matter of considerable interest, because, so far as prehistoric man is concerned, we cannot hope to obtain any direct evidence of the condition of his higher nerve centres, and must depend for an estimate of his cerebral development upon those more or less perfect skulls which have resisted for so many ages the corroding hand of time. The outer surface of the skull presents features which are due to other factors than brain development, such as muscles, jaws, and teeth; while an examination of the cranial cavity not only gives us information as to brain form, but by affording a comparison between the external and the internal surfaces of the skull wall it yields us a valuable clue to the real significance of the external configuration. Professor Symington cautioned his hearers that though the facts that can be ascertained from a study of a series of skulls regarding the size and form of the brain are both interesting and important, there are distinct limits to the knowledge that can be obtained from this source. The absence of the brains belonging to the skulls prevents our gaining valuable information as to racial characters. We know that, as a rule, the brains of the less civilised races are smaller, and the convolutions and fissures simpler, than those of the more cultured nations, but beyond this little has been definitely determined. As the results of investigations in human and comparative anatomy and physiology, we have learned that definite areas of the cerebral cortex are connected with the action of definite groups of muscles, and that the nervous impulses starting from the organs of special sense reach definite cortical fields. But not more than a third of the convoluted surface of the brain has so been marked out, and the remaining two-thirds still form unexplored territory. Do these afford a localisation of special mental and moral qualities or tendencies?

The Floras of the Past.

One of the most striking of the sectional presidential addresses was that given in Section K (Botany) by Mr. Seward, F.R.S., of Cambridge, one of the most prominent palæophytologists of the time. In the brief space of an hour he took his audience over the leading features of the floras of the past, sketching the gradual course of the development of plant life from age to age as told by the traces of the rocks, and pointing out the distribution in space of the most prominent forms of vegetation during those successive periods. It was a great task, and in the hands of many men the effort to deal with such multitudinous detail in so brief a period would have resulted in hopeless confusion. The story as told by the president of the section was, however, clear and lucid,

as well as graphic. At the outset he gave a brief *résumé* of the leading features of the flora of the coal-measures, with which botanists are most familiar, dealing with the well-known types of the ancestors of club-mosses, horsetails, and ferns, and with the less prevalent representatives of the gymnosperms. He passed on then to point out that during the Permo Carboniferous era two large botanical provinces existed, of which the one characterised by those types stretched across the western states of North America, passed through Europe into China, and reached as far as the Zambesi. The other—in the flora of which few, if any, of the plants of the first could be found—was confined to the southern hemisphere, and extended from South America, through India, to Australia. Broken up, consequently, by large areas of sea, it could hardly be recognised as a province, but seemed like a series of disconnected areas. The chief plants of this province were the well-marked ferns *Glossopteris* and its allies. Originating in the south during the subsequent geological periods, this flora pushed forward northward over a portion of the area previously occupied by the northern flora, and came to be recognised as far north as Russia. As time passed on these old types disappeared, and were replaced by a prominent gymnospermous vegetation. The Mesozoic epoch was characterised chiefly by the abundance and wide distribution of plants of the family of the Cycads, now represented chiefly by the so-called sago-palms. With these were found also a large number of conifers, of a type resembling, in many respects, the conifers of to-day. The old horsetails, ferns, and lycopods had almost disappeared. Again, later, the scene changed; and the representatives of the modern flora, the angiosperms, appeared, and rapidly assumed predominance. The relative suddenness with which these changes occurred, and the completeness of the changes, were remarkable. Three successive floras have appeared in the history of vegetation. The two earlier have flourished, have held sway, and have disappeared; the third, the now dominant type, still holds its own.

Vegetable Colonisation.

This year something of a new feature has made its appearance in the botanical section, in the form of a series of papers dealing with adaptations of plants, and their struggles for supremacy when many of them have been forced into competition. A paper of much interest in this connection was read by Miss Stopes, on "The Colonisation of a Dried River-bed." In the county of Kent, near Northfleet, a stream flowing into the Thames was artificially dried up by the pumps of a new water-works, and the bed consequently became a mere muddy expanse. Soon vegetation made its appearance on the mud, and competition set in. The first denizens were a few aquatics, which survived the drying up, and some semi-aquatic plants, which became dispersed over the area. The banks were lined by the terrestrial plants that had been the neighbours of the stream. During the first year all the plants then sparsely distributed held their own in common, and made headway. The struggle was one against the difficulties of the changed environment; and little by little some dropped out, while others established themselves. The second year showed both aquatics and semi-aquatic forms flourishing side by side, but individual differences becoming marked. The terrestrial forms were tending to gain ground, and the weaker of the semi-aquatics were thinning out. The true aquatics were disappearing by degrees, remaining in evidence mainly where sheltered conditions could be obtained. The third year showed a further advance along the same lines; though the wet season was greatly in favour of the water-plants, they made but little headway against their terrestrial neighbours, which were rapidly assuming predominance. The species of the latter were not, however, present in the same proportions as in the pasturage upon the banks of the original stream; the new conditions favoured some, while they repressed others. The Leguminosæ especially were unable to establish themselves.

Sun-spots and Terrestrial Changes.

Sir Norman Lockyer read a paper on this subject in the astronomical section. He reviewed the work done in this department during the last quarter of a century, and said that in 1878 Mr. Chambers, in his studies of the Indian barometer, found a remarkable degree of resemblance in the progression of barometric pressure and sun spots, low pressure being about the time of the sun-spot maximum, and we might conclude that the sun was hottest about the time when the spots were at the maximum. In trying to connect the Indian famines with the indications of the barometer, Chambers found grounds in the course of his inquiry to infer an intimate relation between the variation of the sun spots, barometric pressure, and rainfall. To see whether such a striking and important result was limited to India, an important series of pressures obtained at a station in South America was studied, and again a striking relationship was found to exist between the three factors under consideration, but with the important difference that high pressure in India was represented by low pressure in South America. The discovery of this barometric surge marks a most important advance.

The Antarctic Expedition.

Considerable interest attended the appearance of Lieutenant Shackleton in the geographical section, where he gave an account of his personal experiences in connection with the work of the *Discovery*. He was one of the party who proceeded eighty miles further south when the ship put in for winter quarters in M'Murdo Bay. He described the daily life in this far-off region with a good deal of humour, while he put forward a very vivid presentment of the hardships of the expedition. He spoke of a blizzard blowing at the rate of ninety miles an hour; of intense cold, such as brought the thermometer to indicate ninety degrees of frost; of shortness of food on sledge expeditions; and of other difficulties that had to be encountered. At the most southerly point reached animal life was practically absent, but around the winter quarters of the ship the biologist of the expedition had collected about five hundred new species of marine animals. The *Discovery* was, when Lieutenant Shackleton left, fast in the ice five miles from the line of the open sea. During the year the weather had been so severe that five miles of ice represented the difference between what might be called the coast line this year as compared with that of last year.

Exploration of Irish Caves.

In 1902, at the instance of a committee of the geological section, explorations were conducted of certain caves near Ennis, County Clare, by Dr. Scharff and Mr. Ussher. They were found to be prolific in remains of animals now extinct in Ireland, and in human relics of different periods. In most part of the caves two strata were distinguishable, a brown earth, occasionally containing calcareous tufa, and a lower yellow clay. In the former stratum there were found much charcoal, bones of man and of domestic animals in a fragmentary state, and also objects of human art of various descriptions—a bronze pin or awl, an amber bead, a bracelet of bronze and another of gold. In the lower stratum bones and teeth of reindeer and bear occurred, the size of the latter pointing to the existence of animals of enormous dimensions. The system of caves proved to be very extensive; the first was traced for about fifty feet into the rock, when from it extended a series of galleries, some being very wide and confluent. One of the latter was excavated for a distance of sixty feet, and it was there found to be crossed by another cave that led out to the cliff, but whose orifice was blocked. The system was so extensive and complex that the discoverers named it the Catacombs. In one part of it human remains were frequent, and in one place an assemblage of these included a cranium, not far from which there were two stout iron knife-blades. A strap of bronze, bearing a buckle, was found elsewhere, ornamented with an interlaced pattern in silver plating. In other caves were chipped flint scrapers, a bone piercer, a tusk of a large boar, pierced as if to form an amulet, and a marine shell similarly perforated. Several marine shells occurred, though the sea is many miles away from the site; also much charcoal and bones of the horse, ox, pig, sheep, goat, and dog. Bones and teeth of bear and reindeer were of daily occurrence in excavating the deposits, and in a few cases were obtained pieces of the bones and antlers of the great Irish elk. There are reasons to believe that the

unexplored portions of the Catacombs considerably exceed in extent those that have so far been examined.

At the meeting of the general committee held for the purpose of making arrangements for future meetings, a very cordial invitation from the governments of Cape Colony, Natal, and the Transvaal to hold the meeting for 1905 in South Africa was enthusiastically accepted. The headquarters of the meeting will be at Cape Town, and visits will subsequently be paid to the other colonies. Arrangements for special rates of transport for the Association have already been initiated. At the same meeting the Right Hon. A. J. Balfour was elected president for the meeting at Cambridge, which will commence on August 17, 1904.

SCHOOL CURRICULA AT THE BRITISH ASSOCIATION.

THE room set apart for the use of the education section of the British Association this year, at its meeting at Southport, is known as the Cambridge Hall. Till the opera-house was built, the hall did duty as a theatre for this gay little town. Even yet it appears to be a sort of theatrical reservist, for the first meeting of the section found the chairman and his committee seated on a stage, and projected against a sylvan scene that has doubtless figured as the Forest of Arden.

The presidential address was a sober, straightforward account of the origin and work of the Science and Art Department, with which Sir William de W. Abney was so long and so honourably connected. It was no unsuitable opening to a discussion on curricula to give a history of one of the most noteworthy attempts to impose by suasion of various kinds a certain form of curriculum on a whole section of the nation. Sir Michael Foster, in thanking Sir William for his address, did no more than justice in emphasising the fairness and broadmindedness with which the subject was treated.

At the request of the committee, papers had been prepared by no fewer than eight well-known educationists. These had been all printed in a special supplement to an educational monthly which was on sale at the Association book-stall. It was therefore assumed that the section already knew these contributions to the discussion, and the unfortunate authors were asked on the spur of the moment to give a synopsis of what they had said. This was done to save time, but it is doubtful whether time is ever saved by trying to express orally what one has already written. Most of the speakers did not try. Professor Michael E. Sadler made no pretence of keeping to his written text. That was on record for any one who cared to read, so he wandered afield, to the great advantage of his audience. His paradoxical five requirements from the ideal teacher found great acceptance among the audience: (1) Sympathy; (2) a hot temper; (3) a sunny disposition; (4) a sharp tongue to be used on proper occasions; (5) a young spirit under gray hairs. He wanted to know a great many things; among them why manual work of an interesting kind was not taken up in secondary schools. Why, for example, should not the boys in such schools build their own pavilion and decorate it? Why should they not print as well as write and edit their school magazine? At a later stage a cold-blooded critic answered callously: (1) Because they couldn't; (2) neither could their masters. But the audience felt that the professor was on the right lines. He cannot help being interesting and impressive. Professor John Adams worked out the implications in a name applied to the three R's by Sir John Lubbock—the "knife-and-fork studies," studies that are merely instruments to be used on other studies that may therefore be called dinner studies. The names are good, and mark a real distinction; but the distinction is not fixed. Everything depends upon the stage at which we take a subject. While we are learning a subject, whatever may be our ultimate use of that subject, it is a dinner study. By-and-by, when we are familiar with it, we may reduce it to the level of the knife and fork. Educational progress may indeed be described as the process of turning dinner studies into knife-and-fork studies. This movement has an important bearing upon the question of curriculum; we have the dynamic element as well as the static. Professor Adams said that there is a danger of our young teachers becoming exclusively scientific in their mental attitude, from the kind of training they are receiving. Among the young teachers being trained in London it is becoming increasingly difficult to get candidates for the B.A. degree, particularly among the young men; the preference is all for the B.Sc. For this the regulations of the London University regarding Greek are largely responsible, though there are other causes.

The next speaker, T. E. Page, one of the masters at Charterhouse, made an excellent impression on the section. To begin with, all present were delighted to see among them a genuine representative of a class of teachers who are noted for their aloofness. Mr. Page was frankly humanist. Shelley told him that "speech created thought," and that was enough for him. Max Müller found material for a bulky volume in the discussion of the relation of speech and thought, but this aspect of the matter did not seem to occur to Mr. Page. He proceeded to attack the paper prepared by Professor H. E. Armstrong; which was unfortunate, as the professor was absent at that moment, taking part in the discussion of the radium question. Mr. Page spoke as a pessimist who had become reconciled to his pessimism. His speech acted like a tonic on his audience.

Quite a different speech was that of Mr. G. F. Daniell, Chairman of the Education Committee of the Teachers' Guild. It embodied the results of very careful inquiries among teachers of all classes of schools. His paper is valuable for reference; it cannot be summarised.

Miss Maitland of Cambridge Training College found a certain paragraph in Professor Armstrong's paper very objectionable. The paragraph deals with the education of women. Miss Maitland indicated that women's education has been bad mainly because codes and curricula for girls were all drawn up by men. She further commented on the number of training colleges for women over which are placed men principals.

At the afternoon sederunt certain propositions or resolutions had been prepared by the committee to focus the discussion. The first of these ran: "It is desirable that specialisation should be deferred to as late a period as possible in the school career, and that the early curriculum should be so arranged as to lay a good foundation in English subjects." This was felt to be so vague as to be almost worthless. It was suggested that instead of "as late a period as possible" should be inserted "to at all events the last two years of a boy's school life." But it was felt that this might affect different schools in different ways, so the vaguer form was preferred, though on a show of hands only some twenty voted for, and two or three against. The chairman pointed out that most of the members did not vote at all. The interesting thing about this discussion was the number of different meanings attached to the word "specialisation:"—1. Devoting the greater part of the school time to a subject or limited group of subjects. 2. Directing special attention to subjects that have a direct bearing on the life-work of the pupil. 3. Everything but Latin and Greek. This third and astounding meaning is that attached—the section was solemnly assured—to the word by a section of public schoolmasters who treat the classical languages as the normal, and any deviation from them as a kind of specialisation. Mr. Yoxall indicated that the line of specialisation that would most probably be followed as a practical expedient would be specialisation of schools rather than specialisation within each school. Professor Sadler and Miss Cooper of Oxford maintained that specialisation was, after all, not so much a matter of subjects as of ways of viewing subjects—mental attitude, in fact. Literature can be taught scientifically, and science can be treated in literary form. There was a very general feeling that the teacher counted for more in this connection than is generally believed, and it was very emphatically stated by several of the speakers—notably those who were not themselves teachers—that better payment of our teachers would cure many of the defects brought out in the discussion.

The second proposition—"It is to be regretted that the influence of public school entrance and scholarship examina-

tions encourages the premature devotion of too much time to classics. It would be desirable that the study of Latin should not be taken before, say, twelve years of age, and that the language teaching up to that time should be confined to the mother tongue and one modern language"—met with practically no opposition. One wonders why. Probably the explanation is twofold. 1. The general environment of the British Association is scientific, and therefore the usual classical bias was absent. 2. The sederunt was nearly over, and everybody was anxious to be off. In any case the result is remarkable.

The third proposition—"That a large measure of practical instruction should be included in the school course; and that both literary and practical instruction should be given throughout and made interdependent"—was not formally agreed to till the morning of the second day. The subject of the education of girls was then introduced by Miss Burstall of Manchester Grammar School. She laid great stress on the training of the emotional and æsthetic sides of the girls' nature. The curriculum should be threefold: one-third mathematics and science; one-third language; one-third humanistic, including what are known as English subjects. If girls are to learn only one language, let it be French, not Latin or German. What is wanted is the knowledge of a new environment. This the Gallo-Roman element in French supplies, while German presents Teutonic elements too much akin to our own. By the term domestic profession must be understood "living at home," as well as any form of domestic service or domestic government. Parents often prefer to do their own training of their children in domestic matters, which increases teachers' difficulties. For clever girls, Latin and Greek have been found to be the favourite subjects, and that without any pressure or persuasion from without. Specialisation should be in the same school rather than in different schools. Teachers require more freedom.

Professor Armstrong next gave his contribution. He confined himself largely to that paragraph of his printed paper that dealt with women's education. Miss Burstall, he explained, was so broad-minded and original in her views that she was the exception that proved the rule he had laid down in his paper. He was quite willing to put "men" instead of "women" in the sentence, "Women are teaching in the most thoughtless way possible." He took the biological line of argument. Woman is not undeveloped man, but different; therefore her education should differ radically from man's. Professor Armstrong supported his case by reading two long letters—one from Lady Magnus, and the other from a lady equally distinguished for culture and commonsense. As the professor went on with his argument it was not difficult to understand why he is so often attacked. (That very morning, in the section, a teacher had said some very bitter things about the heuristic method and its chief exponent.) He makes men and women think. If they think with him, he is pleased; if they think differently, he is pleased that they think at all.

Miss Maitland followed with an explanation of why women at first claimed to be treated exactly like men in educational affairs. It was the only course open to women to prove their equality. Mr. Yoxall found in Professor Armstrong's speech much paradox and wild assertion, and referred to the excellent work at present done for and by girls in the Board Schools and other elementary schools, where there is practically all the differentiation that is required. A lady member wanted to know whether *practical* training means (1) preparing for one's life work, or (2) doing a thing for oneself. Out of the discussion emerged the important co-education question. It was not included in the programme, and many of the members did not like its being introduced; but there it was, cropping up in speech after speech. One teacher was able to give his experience of the very successful work of the co-education system in a boarding school. The question, however, was usually treated from the economic side. In country districts, Mr. E. Gray, M.P., pointed out, schools of a higher type cannot be maintained for boys and girls separately because of the small numbers, but if they can be taught together the thing is possible. He maintained that it was a question of great practical importance at the present moment. Mrs. Shaw objected that all this domestic training was directed to producing good wives and mothers; but why not good husbands and fathers? Mixed schools she maintained to be necessary for the years thirteen to fifteen. One speaker brought forward the argument that girls should be taught exactly the same as boys, if for no other reason than that so many girls have to teach boys.

What is called the sense of the meeting is represented by the four following propositions, which were received with almost complete unanimity:—

1. It is desirable that, in organising the curriculum, there should be some differentiation, especially in science, between courses of study for boys and those for girls, more particularly between twelve and sixteen years of age.
2. That for *all* girls literary and artistic instruction is of the highest importance; at some period of their school life practical instruction in the domestic arts should be provided, based on and correlated with elementary science teaching.
3. With a view of obviating over-pressure, injury to health, and superficiality, girls who intend to proceed to college, or to enter a literary profession, should in general remain at school till eighteen years of age.
4. It is desirable that County and Borough Councils and other authorities offering scholarships for girls to enable them to proceed to college should not expect them to take up their scholarship before they reach the age of eighteen.

Commercial education was introduced in a breezy speech by Mr. J. L. Paton of Manchester Grammar School. He deplored the contemptible contempt for commerce shown by certain classes. It was an open secret that shorthand and book-keeping are the decoy ducks used by skilful headmasters to induce parents to keep their boys one year longer at school. Commercial schools should not be separate schools. He differed from Mr. Yoxall's view that we were moving toward specialised schools. The tendency is the other way in Germany. In every case commercial education should be supersecondary. In purely commercial centres mathematics and modern languages should form the basis, though in manufacturing districts perhaps science might be important. Geography and history, in proper proportion and relation, and political economy would make up an excellent curriculum. Does such an education pay? It is practised in faith. It will pay in the highest sense, and in the long run in the lower sense too.

Mr. W. C. Fletcher of Liverpool Institute was rather astonished to find his paper included under the head of commercial education, but he didn't mind very much. He put in a strong plea for the imagination and the cultivation of music. He defended handwork from the strictures of Mr. Page, who maintains in his paper that boys can readily learn to use their hands without training. Mr. Page had evidently never tried to get a class of boys to handle set squares. The hand cannot be trained without the mind; and there is the great advantage that in handwork errors are self-demonstrated.

Sir Oliver Lodge, who had dropped in once or twice from other sections, now came to the platform to express his surprise that when teachers spoke so much commonsense as he had heard in that room, the schools throughout the country should be in such a bad state. The explanation must be some sort of coercion. What was wanted was emancipation. Sir Oliver was careful not to say what teachers were to be emancipated from. As to curriculum, he could not quite understand what was meant by "useless;" this term he regarded as pre-scientific. The faults in teaching, so far as he could learn, were nearly always in the lower classes. Most discussions deal with boys in the Fifth or Sixth Form stage. Now the really difficult stage is between the kindergarten on the one hand, and the higher classes on the other, and it is in dealing with this stage that teachers need special training.

Mr. Hamilton, the secretary of the Moseley Commission, explained the nature of the Commission, and asked for hints from the section, but no hints were forthcoming. Next Mr. Leonard Humphreys, representative of the Private Schoolmasters' Association, gave his views on the rhythmic nature of the progress of education. The last speaker was a master from the Manchester Grammar School, who had just returned from Germany. He gave some valuable information about the actual state of commercial education there.

BY MANY HANDS.

"Quot homines, tot sententiæ."

"*HUMANUM est errare*," says the old Latin grammar tag, and one of the things in which it is most human to err is the marking of examinations and the assessing of the progress made by pupils. Every pedagogue must have experienced this difficulty, and any observant layman must have noticed the preponderance of "good" and "very good," even "excellent," in the assessments of examiners and teachers. A curious note on this subject appeared in a recent issue of the *Westminster Gazette* with reference to an investigation made in America on titles and distinctions by Professor le Conte Stevens. He has arrived at the conclusion that the upward tendency in all systems of assessment is the result of an unselfish trait—the desire for expressions of esteem, which, we suppose, prompts the assessor to rank a pupil higher than his deserts, in an unselfish eagerness to please him.

The Unselfish Human.

THIS decidedly human desire has wrought havoc in America, where degrees and marks of distinction have been multiplied and showered around in such a way as to be practically worthless. When D.D. may stand for Doctor of Dancing as well as Doctor of Divinity, one can easily understand the disgust of university graduates; and if M.P. (Mistress of Philosophy) were ever to cross the Atlantic and become acclimatised here, even representative legislators might object; while M.P.L. (Maid of Polite Literature) would only give rise to inextinguishable laughter. But, to return to our muttons, Professor Stevens gives a striking illustration of his point. In a school the system of marking adopted was "Bonus," "Melior," "Optimus," upwards; with "Malus," "Pejor," "Pessimus," downwards. The curve of probability, according to him, would give 30 per cent. of "bonus" and "malus" respectively; 16 per cent. of "melior" and "pejor" respectively; with about 4 per cent. of the highest and lowest denominations. But do you think that the marking of the examiners corresponded to the proportions thus mathematically plotted out? Nothing of the sort.

His Rage for Distinctions.

IN time nobody fell below "malus," and not one-half of those who ought to have received this mark got it. Thus "bonus," instead of being a desirable mark, became, he says, a disgrace; and "Optimus" was the fortune, not of the few best, but of all who were only a little above the average. So much for unselfish human nature; and how many times have we seen the same process in progress!

How he apportions them.

Disgusted with this result, a new system of assessment was arranged—"disapproved," "approved," "distinguished." But unselfish human nature romped in again and put the examiners to rout. The curve of probability shows, on this plan, 60 per cent. of approved pupils, with about equal portions of "distinguished" and "disapproved"—that is, about 20 per cent. of each, a proportion which falls in with close approximation to that which common-sense experience would establish. But, alas! Professor Stevens says that in a short time some bad pupils were "approved," and nearly all the good ones were "distinguished!"

THIS is the first time we remember to have seen the question of marking discussed from a scientific point of view, and we are struck with the closeness with which the professor's figures approximate to the results which experience bears in on the observant pedagogue. But how are we to proceed? How are we to overcome this unselfish tendency of human nature which makes even an *Orbilius Plagosus* disposed to estimate the destroyers of his daily peace at a higher value than the real one? You can't expel nature with a fork; and if we must have marks of distinction, we suppose the time will come when everybody will possess them, and then, all being on a level, we shall have to make a clean sweep of everything and begin afresh. But in the meantime this tendency on the part of assessors to give an upward direction to their classifications produces some quaint results.

What is the Remedy?

FOR instance, we know a prominent School Board where promotion depends on the attainment of certain classification marks, which are adjudged by the Board's officials. The human tendency noted by Professor Stevens is clearly apparent in their assessments; for instead of 60 per cent. of passable persons to 20 per cent. of distinguished ones, the lowest assessment appears to be good, which means so little as to be regarded as almost an insult. The great majority of those classified are "very good," which is, as Euclid would say, absurd. So that to draw some few out of the common ruck of "very goods," all sorts of diacritic signs, plus and minus, with stars and dashes, lead on to "excellent," the frequency of which is almost enough to brighten the heart of the most desperate pessimist. But something must be at fault with a system in which "good" no longer means "good," but is equivalent to "bad;" though if human nature is the cause of this confusion, we confess we don't know how to correct it. The subject is an interesting one, and we do not doubt that a careful observer among teachers, who have much to do with the adjudication of positions of merit, could supply some curious illustrations of the tendency noticed by Professor Stevens.

For Example—

THERE is one thing in which a keener interest appears to be taken in France than in England. It is the history of their primary schools. In the French pedagogic journals one constantly comes across an investigation which has been made into the history of some school or other, often in quite out-of-the-way quarters. The archives of towns and communes have been ransacked for documents, and much light is thrown on the historical development of education in that particular district. These investigations palpitate with interest, and curious are the revelations of customs, curricula, the teaching body and their position, duties, and emoluments, which are brought to the light of day. The current number of the *Revue Pédagogique* contains a similar article, giving the history of a village school during a half-century, 1764–1823, which we commend to the notice of our readers. The great public schools of England have found their historians, the schools of Reformation and pre-Reformation times have been cared for by

Mute. Inglorious—but Worthy.

Leach, Bass-Mullinger, and others; but there must be many a humbler school, in less prominent positions, whose history would throw much light on the life of the people, and which yet waits for its biographer. It is a pleasure to note the vivid interest which awakes in France in these obscure and forgotten glowworms of educational light.

IN the country and city where Ovidius Naso wrote his *Tristia* there is a Minister of Public Instruction, the Honourable Signor Nasi by name, who seeks to remove the tristness of the Italian teachers' lot by requiring them to study and teach their pupils *The Duty of Man*, by Mazzini. Such was the stone offered to the Italian schoolmasters for bread, and they seem to digest it badly. For, if one may trust the news in *L'Européen*, "these unhappy pariahs of education, whom successive governments have fed with promises and fine words, are losing their patience at last." There were signs of this to be noted at the Conference of the Italian National Union of Schoolmasters, held at Bologna last year, the representatives listening with sympathy and applause to the harangues of certain Socialists named Cabrini, Soglia, and Marchesiana. For the last twenty years the Italian teachers have begged in vain for a slight amelioration of their poverty; but Rome, where the original pedagogues of all were treated so badly under the Republic and the Cæsars, treats their Italian successors with nothing better than fair words, even under the constitutional monarchy of these latter days. Hence the Socialistic propaganda among them; hence the impending of an Italian teachers' strike. Milan is the furnace of Socialism in Italy, and in Milan the teachers have recently held a meeting to consider a mode of revolt. The movement is spreading to all the chief cities of Italy, and the Italian National Union of Teachers is making members every day.

A Teachers' Strike.

THE government have some excuse for turning a deaf ear to the teachers' claims, maybe; the finances of the nation are in anything but a flourishing state. To satisfy the teachers it needs *de l'argent, beaucoup d'argent*. And where to get it? By new taxation? Already the Italian people are *saigné à blanc;* and even the teachers oppose the idea of further taxes for their behoof. There is but one way of improving the condition of the schools and the teachers in Italy, the teachers say, and that is by reducing the Military Budget. The Conference of their Union, held at Florence, has declared that the remedy lies therein. But an ambitious government refuses to lay down any of the nation's arms, and therefore the teachers have come to the conclusion that they must do as the organised teachers of England have successfully done—resolutely take part in public life. They are therefore silently but assiduously preparing for something which is perhaps unexampled, and of which the consequences cannot be estimated—to wit, a teachers' strike. Some fine day before long, if their plans work out successfully, the teachers will desert the schools, without fuss or bother, but with determination not to return to desk and blackboard until justice to their famishing wants has been done. And they will appeal to the training-college students to be professional, and not to fill the vacant places.

The "Eternal Want of Pence."

N.U.T. NOTES.

WITH feelings of great satisfaction I found myself elected by the Executive as one of the Union's representatives to the third Congrès des Amicales d'Institutrices et d'Instituteurs Publics de France et des Colonies—a conference to which the significant legend was appended, "*Autorisé par M. le Ministre de l'Instruction Publique.*" My *compagnon de voyage* was Mr. George Sharples, the vice-president of the N.U.T., a man of delightful personal qualities, full of humour as well as sound common-sense, singularly well-informed on *affaires* professional and otherwise, whose well-stored mind and equally well-developed *corpus sanum* made him an ideal *camarade*. The Congress of French Teachers is a modern institution, held once in two years. Previous gatherings had taken place at Paris in 1899, and Bordeaux in 1901; and at the latter city Messrs. Blacker and Yoxall, M.P., had attended on behalf of the Union. The French national organisation possesses neither permanent offices nor salaried officials. Yet, in spite of this and its loosely-strung constitution, it is able to raise the finest conference I have seen outside my own country, and I have now assisted at "Teachers' Parliaments" in seven or eight different countries. There are various ways of getting to Marseilles, and Mr. Sharples and I finally decided to travel *viâ* Paris and the Chemins de Fer de Paris à Lyon et à la Méditerranée. We journeyed to Paris by the Newhaven-Dieppe route, and for two reasons: first, because it is *très bon marché*; and, secondly, because of the fine railway ride through Normandy. The splendid *S.S. Arundel* rocked more than a little on the "poppy" Channel—there was "half a gale" blowing both on our outward and homeward journeys—yet *mal de mer* had neither terrors nor qualms for the English deputation. We made a short stay in Paris, long enough, however, to refresh our eyes with a sight of some of the magnificent treasures of the Louvre, to sip our *café noir* on the gay boulevards, to tread the stately promenades of the Champs Elysées, and even to traverse some of the *allées* of the glorious Bois de Boulogne. Singularly enough, we left Paris on the day of the fearful holocaust on the Métropolitain, although the sad news had not then leaked out. 'Tis a far cry from Paris to Marseilles—538¾ miles—and the journey was sufficiently tiring. Compensation came, however, in the guise of superb scenery, the valleys of the Saône and the Rhone being both grand and picturesque in turn. Dijon, Macon, Beaune, Lyons, Avignon were some of the places we passed through, and our inability to linger for days midst such pleasant surroundings was a source of great regret.

To Marseilles: En Route.

THE eve of the Congress was devoted to an informal reception of the *congressistes* at the headquarters of the Marseilles teachers. The Conference proper commenced at the, to us, unusually early hour of 8.30 a.m.; yet, early though it was, between 1,000 and 1,500 teachers were present at this *séance d'ouverture*. M. Célestin Michel, the president of the Organisation Committee, welcomed the visitors in felicitous phrases, and then M. Bontoux, the general secretary, gave in detail an account of the committee's labours. There being no president—or, indeed, any other officer—of the national organisation, Conference had to elect its own chairman

An Early Start.

Next Month:

PRACTICAL AIDS IN ARITHMETIC.

and secretary, and the choice naturally and aptly fell on Messrs. Michel and Bontoux, local gentlemen who had borne the heaviest share of the burden of the preliminary preparations, and were most *au courant* with the Conference agenda. The president's thanks were brief and hearty. His first official act was to introduce three resolutions:—1. An expression of devotion to the Republic, and "profound respect" to M. Loubet. 2. An expression of confidence in M. Combes, the Prime Minister, and his educational policy. 3. An assurance of the teachers' whole-hearted devotion to their duties, addressed to M. le Ministre de l'Instruction Publique. These motions were enthusiastically agreed to. Next a gentleman "from the floor" suggested a congratulatory vote to M. le Ministre de la Marine, and brought down the house by a happy reference to the nuptials of M. Pelletan with a schoolmistress. Conference felicitated M. Pelletan most heartily.

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Three Sections.

THREE questions only were discussed during the four days allotted to business proper, but these three were of the highest importance. First on the *ordre du jour* stood "La Mutualité," second and third came "L'Indemnité de Résidence" and "La Composition française." These subjects had been fully investigated by the local associations during the preceding twelve months, and valuable preliminary reports were in the hands of each *congressiste*. On the opening day Conference elected officers for each section, and then the members resolved themselves into three huge committees, which met simultaneously in order to adopt resolutions. These resolutions were afterwards submitted to the full Conference (*séance plénière*), and in the main agreed to. The most important session was presided over by M. Combes, the French Prime Minister, who delivered an eloquent address, eulogistic of the teachers and their labours. He also bestowed various decorations on certain lucky individuals, and midst salvos of applause kissed on both cheeks the fortunate recipient of the Légion d'Honneur. M. Pelletan, the famous (some might prefer notorious) Ministre de la Marine, was also present, but did not speak. At this *séance plénière* I had the honour of saying a few words, and nothing could exceed the cordiality of the reception given to Mr. Sharples and myself as we stood at the tribune. Only the inability of the band to remember "God save the King" prevented our own national anthem being heard by the three or four thousand people then assembled.

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The Ex-President's Speech.

POSSIBLY the following may interest the many readers of the *Practical Teacher* possessing a nodding acquaintance with the French language:—"Voulez-vous me pardonner si j'essaye de vous parler dans une langue qui, quoique aimée et bien connue de vous tous, est un peu étrangère à beaucoup de personnes qui habitent au nord de la Manche?

"J'estime un privilège et un grand honneur d'être présent au troisième Congrès des Instituteurs et Institutrices de France. Accompagné par mon bon ami et collègue, M. George Sharples de Manchester, je suis venu vous transmettre les félicitations et les souhaits les plus cordiaux de l'Union Nationale des Instituteurs Anglais, une organisation qui, comme quelques-uns d'entre vous le savent, compte cinquante mille membres. Nous espérons très sincèrement que ce congrès de Marseille sera le meilleur et le plus influent qui ait jamais été tenu. Nous espérons également que vos délibérations seront couronnées du plus grand succès possible.

"Quoiqu'il y ait une différence de nationalité entre nous, visiteurs Anglais, et vous-même, je suis fier et heureux de penser que la tâche, les espérances et les aspirations des Instituteurs Français et Anglais sont les mêmes. Travaillant dans différents pays, nous sommes néanmoins membres d'une grande armée, combattant de notre mieux les ennemis communs—l'ignorance et le vice.

"Les mois qui viennent de s'écouler ont apporté leur témoignage des sentiments cordiaux qui existent entre les chefs des nations Française et Anglaise. De notre côté, nous fûmes gratifiés et charmés de la magnifique bienvenue que la France accorda à notre Roi; et quand votre estimé Président, M. Loubet, nous honora d'une visite, l'Angleterre fit tout ce qu'elle put pour lui faire souhaiter d'y revenir. Les Anglais qui connaissent la France l'aiment et aiment son peuple. Je crois pouvoir aussi dire que les Français qui connaissent l'Angleterre possèdent les mêmes sentiments aimables envers elle et son peuple.

"Notre ardent désir est que ces visites internationales des Instituteurs fassent quelque chose pour créer parmi les nations du monde entier un esprit d'amitié et de réele fraternité. Plus les différentes nations se verront et se connaitront plus il sera difficile à ces conflits internationaux de s'élever. Et nous autres Instituteurs, j'en suis convaincu, pouvons aussi bien que les diplomates préserver au monde la bénédiction de la paix universelle.

"Pendant beaucoup d'années nous avons eu le plaisir, à notre conférence annuelle, de souhaiter la bienvenue à des habitants de votre charmant pays. Il m'est à peine nécessaire de dire qu'ils furent reçus avec enthousiasme. L'année prochaine, notre conférence aura lieu à Portsmouth, et mon ami M. Sharples présidera. Lui et moi nous espérons sincèrement que votre excellente société y sera représentée, et cela va sans dire que nous ferons tout ce qui sera possible pour rendre le séjour de vos délégués agréable, instructif et très amusant."

* * *

Olla Podrida.

THE next day *Le Petit Marseillais* was good enough to remark: "M. Croft prononce un discours, en un français très correct et d'une rare élévation de pensée. Ses déclarations de sympathie pour la France sont accueillies par une véritable ovation. Très emus de cette manifestation, les délégués anglais remercient," etc.

Throughout the week the attendances were large and the interest in the business well sustained. The social side of the Conference was adequately catered for, and if any visitor left Marseilles without seeing everything of interest in that fine city, it was his own fault. Every day at 6 a.m. parties were formed for a *promenade dans la ville*, and the itinerary was both varied and comprehensive. The hour was a little unsuitable for Mr. Sharples and myself. Nevertheless, we contrived to see the "lions" (and a good deal more) of France's second city. That part which abuts on the Mediterranean is charmingly picturesque, whilst the Italian quarter actually made one thankful for Whitechapel and its purlieus. The author of *La Terre* would have been in his element in depicting the horrors seen near the docks, and to attempt the task with anything less pungent and powerful than Émile Zola's pen would be absurd. One evening the *congressistes* were received by the municipality at the Hôtel de Ville, and the English deputation had the honour of a little reception "all to

itself." After the mayor's graceful and cordial welcome, the band played "God save the King." Next, I essayed a few words of thanks in the best French I could summon, and the vice-president backed up with some vigorous and sensible Anglo-Saxon. (Possibly, as he remarked to me, *sotto voce*, "the good old tongue has never resounded in these halls before.") A most enjoyable affair was the *promenade en mer*. One glorious afternoon, when both sea and sky were perfectly blue, the whole Conference was taken in five little steamers through Marseilles' fine docks, and then for a little voyage on the open sea. Not the least interesting object seen on our "promenade" was the far-famed Château d'If, well known to every lover of Alexandre Dumas' *chef d'œuvre*. The banquet was the bustling, rollicking function that Continental banquets usually are, and some six hundred guests were present. These got a little "out of hand" as the night wore on. Nevertheless, 'twas a triumph of organisation for the capable secretary, M. Pagnol, one of the happiest and withal most energetic of the many excellent people who lavished on us every kindness.

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Accident to Mr. Rankilor.

MEMBERS of the N.U.T. Executive naturally run many risks during their peregrinations, and I recall *contretemps* of more or less serious nature to Messrs. Butland, Jackman, and Winfield within the past two or three years. The latest sufferer is Mr. G. J. Rankilor, who, whilst representing the N.U.T. at the Teachers' Conference in the north of France, had the misfortune to fracture his knee-cap. He was stepping from the carriage of M. Gombert, one of the gentlemen who aroused the enthusiasm of the Buxton Conference, when the unfortunate mishap occurred. Every one will hear, with great regret, that possibly six months must elapse before Mr. Rankilor will be able to get about again. We shall miss his ripe judgment and genial presence at Russell Square. Although one of the oldest members in point of years, he is still one of the youngest so far as spirits and disposition are concerned. Unionists everywhere will join in wishing the speediest possible recovery to the Birmingham Nestor.

* * *

Presentation to Mr. Waddington.

THE thrill which ran through the Bristol Conference when it was known that Mr. Waddington had been defeated at the Executive polls is still fresh in my memory. The Lancashire associations, a year later, made what reparation they could by preferring a practically unanimous request that he would again accept nomination as an Executive member. The demands which his work on both Municipal Council and School Board in his own town (to say nothing of the charge of an important publishing business) made on his time rendered such a course impossible. Next, the Buxton Conference decreed, with cordiality and great heartiness, that the Executive should present a testimonial to Mr. Waddington in recognition of his services; and at the September meeting an album containing the resolution of Conference—signed by the officers of the Union and all the members of the Executive—together with a cheque for the amount authorised by Conference, was duly presented by the president of the Union. The speeches delivered were worthy of the occasion, and Mr. Waddington's reply was an interesting review of the Union's work during the past decade. It will be a generation before we can hope to "look upon his like again." A. C.

NOTES FROM THE NORTH.

Blue-Book 1902 3.

THE Blue-Book just issued gives every indication of, on the whole, a most successful year's work in the schools of Scotland. Standing on the eve of proposed new legislation, we find in it many valuable suggestions as to where improvement can still be made. It cannot be said, even from a most careful and close perusal of the reports of the various inspectors, that we are within measurable distance of perfection But that the year shows steady progress is evident to even the most casual reader. Some of the inspectors, however, give us very little information with regard either to the operation of the new Education (Scotland) Act, or to the new method of inspection. That comparisons are odious we know, yet we cannot refrain from saying how much superior to all the other productions in the Blue-Book is the report on the Western Division. In it we find much of great interest both to the general reader and to the teacher. From it it is possible to extract many valuable hints and suggestions of practical utility; while at the same time it puts in a conspicuously clear and concise manner the various statistics required to estimate fully the progress made during the past year. It may be said without fear of contradiction that this report redeems the Blue-Book from its usual staleness, and does not give us the customary "hotch potch" that does duty not infrequently for a report.

* * *

School Attendance.

IT is gratifying to be able to say that the school attendance for the year shows a decided improvement. The percentage of average attendance is 84·11, as compared with 82·92 last year; and while the numbers on the school registers give us only an increase of 1,000, the average attendance has increased by no fewer than 10,000. As the Lord Advocate for Scotland in his speech on introducing the Scottish estimates pointed out, this increase is entirely amongst the older pupils, while the number of children under seven has actually decreased. Mr. Scougal gives the figures for his district, which show a decrease of 1·2 per cent. of the whole under seven, and an increase of 2 per cent. of those over ten. He adds: "The most significant figures are the percentages. From these it is of interest to note the somewhat curious fall in the relative proportion of scholars under ten years of age, and the encouraging rise in the proportion over ten. Undoubtedly this rise is mainly due to the influence of the Act of 1901; and as that influence becomes more and more operative, we may expect the number of the senior division scholars to show still further relative increase."

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Staff and Salaries.

THE average attendance for the year was 646,501, and there were 11,524 certificated teachers. This works out at a proportion of one certificated teacher for every 56 children. Mr. Rankine, in his general report to the Board of Education on the Training Colleges of England for 1902, says: "To allow 50 children in average attendance to each trained teacher seems a moderate basis of calculation." On this basis Scotland would require 12,930 certificated teachers, so that at present the deficiency is 1,400. Last year there were 7,607 trained teachers; this year there are 7,958—an increase of 351,

or 4·6 per cent.; while the number of untrained—that is, certificated teachers not having passed through a training college—is this year 3,566 as against 3,334 last year, an increase of 6·9 per cent. So that it is evident the training colleges of Scotland are totally inadequate to cope with the demand for trained teachers. This year there is a decrease of 246 pupil teachers, while assistant teachers (ex-P.T.'s) are 2,606 this year, the same as last year. The decrease of pupil teachers is an alarming sign in view of the great increase (10,000) in the average attendance for the year. The average salary of a schoolmaster (whether principal or assistant) is this year £147, 10s. 8d., as against £146, 0s. 11d.—an increase of nearly £1, 10s.; and of a schoolmistress, £73, 9s. 8d., as against £72, 0s. 3d. last year—an increase of £1, 9s.: so that the rate of increase of the salaries of ladies and gentlemen is nearly the same.

IN view of the near approach of the septennial revision of the Superannuation Act of 1898, it is well to note how far the Act has been taken advantage of. During the year ended March 31, 1903, superannuation allowances amounting to £383,12s. 4d. were granted to 14 teachers—8 men and 6 women—who had attained the age of sixty-five years. This works out at an average of £27 per teacher. While during the same period disablement allowances were granted, under Section 2 of the Act, amounting to £642, 19s. 6d., to 23 teachers—7 men and 16 women—or an average of a little over £27. So that disablement allowances and superannuations are practically the same. Since the beginning of the Act there have been paid superannuation allowances to 40 men and 14 women, and disablement allowances to 27 men and 33 women; so that of the 3,525 men who accepted the Act, only 67 have as yet reaped any benefit from it; and of the 4,037 women, 47 have received allowances. The result must be a great increase, we feel sure, in the superannuation allowances to be given after April 1, 1905.

Superannuation.

THE syllabus for the examination for acting teachers for certificates has just been issued. No changes of any importance occur. Application must be made before March 1, 1904, on Form 147. Candidates of either year are to particularly note that the course of instruction in physics and chemistry, any branch of biology, drawing, or navigation, for which they wish to claim marks, must be approved of by the Department, if it is not conducted under Article 91 (*d*) of the Code. No marks will be allowed if the course has not been so approved.

Examination for Teachers' Certificates.

DURING the holidays little has been going on. The various committees have but rarely met, and then only for the discharge of routine work. The Ladies' Committee have made preparations for a meeting on the annual September day, and a very good programme has been arranged. We hope, however, to give some space to it in our next month's notes. The membership of the Institute shows a very gratifying increase, as evidenced by the treasurer's statistics. The membership has now reached 6,116, though this only works out at 53 per cent. of the certificated teachers of Scotland. There is still much need for organisation. The number of new members joined during the year just closed is 657, against 594 last year, and 601 in 1901. The great number of teachers still outwith the ranks of the Institute require to be drawn in. The Ladies' Committee of the Institute have here a great field for successful work. R. G.

E.I.S. Doings.

REPORT ON SECONDARY EDUCATION IN SCOTLAND.

IN the event of a measure being introduced into Parliament next session to deal comprehensively with the subject of education, secondary education will no doubt be co-ordinated with and made part of the general system of national education. In that case the present report on secondary education by Sir Henry Craik will be among the last in which that subject will be treated in a separate volume and apart from the rest of education. It is gratifying to learn that considerable progress has been made in recent years with regard to secondary education, so that there are now very few instances of schools characterised by marked inefficiency.

The report shows that there were inspected last year ninety-four higher schools, of which thirty-two were higher class public schools under the management of School Boards, twenty-four endowed schools, and thirty-eight privately-managed schools. To these schools there were allocated grants to the amount of £26,250 under the minute of April 27, 1899. On the rolls there was a grand total of 17,856, and an average attendance of 16,264, or 91 per cent., as against 84 per cent. in the elementary schools. Of the former number there were no fewer than 8,938 who were over fourteen years of age. This proportion, while it cannot be considered excessive, shows a decided desire on the part of many Scottish parents to extend the years of instruction beyond the minimum required by law.

While a high standard throughout the various schools has been maintained, it has not been the aim of the Department to mould schools to one uniform type. Very wide discretion has been given by the Code to the managers of secondary departments connected with state-aided schools, while, in regard to the higher class schools, the Department has all along desired that local authorities should feel themselves free to vary the curriculum according to local needs. Occasional suggestions have been made, but these were not intended to limit the initiative or the responsibility of local managers.

Absolute discretion has been given to the inspectors in regard alike to the methods of examination followed, and to the points selected for particular observation; but at the same time they have been asked to direct special attention to the pronunciation of modern languages—an aspect of the teaching that only admits of being adequately tested orally. Last year the Department made the issue of Leaving and Intermediate Certificates to individual pupils in every school dependent upon a satisfactory report being given by the inspector as to the appearance made by each candidate under oral examination, with, as is claimed, a very salutary effect.

While, on the whole, progress has been made, there are many points in regard to which further improvement is desired. The premises of the higher schools do not in all cases compare favourably with those of elementary schools. Local effort is essential for the equipment and prosperity of secondary schools, and it is felt that out of the rates there might be a more liberal expenditure in this direction. School Boards still frequently show a certain timidity about incurring expenditure, from a fear that secondary education may be considered an affair which interests one class only, and not the whole community. This is a matter which can only be altered by improved public opinion. While the Department maintains that there can be no greater error than that of unduly multiplying the number of higher class schools, and thus producing a wasteful overlapping of agencies, it yet hopes that the constituencies will become convinced that adequate provision for higher education is a matter of vital interest to every section of the community; that wise expenditure in this direction from local resources will be productive of much benefit, and will ultimately prove of the greatest profit to the inhabitants of the district prepared to

face it; and that no expenditure is more efficacious than that which develops the equipment of higher class schools, devoted mainly to secondary education in its various branches.

Again, inspectors have very often to lament that the pupils are withdrawn at an age too early to benefit fully by the liberal provision made for secondary education. The only remedy for this lies in the growth of a more enlightened public opinion. Comparison between the results achieved by secondary schools in Scotland and in Germany is deprecated as unfair. So long as the Scottish lad continues to leave school two or three years earlier than his German contemporary, so long must the responsibility rest, not upon teachers, but upon parents. The longer time spent at school, so far from being a disqualification or handicap in the commercial race, provides, according to the report, a preparation and training for a business and mercantile career for which no multiplication of studies and examinations during a brief school life can in any way make amends. The dissatisfaction in Scotland regarding the defective education of apprentices is considered a healthy sign. In the opinion of Sir Henry Craik, the educational machinery of the country can never have a fair chance until merchants as a body set their faces against putting boys into business at thirteen or fourteen, and in the selection of apprentices give preference and reasonable encouragement to those boys who have profited by their school career.

By far the most serious feature revealed by the inspectors' reports is, we are told, the steady growth of overpressure in the upper classes of many of the secondary schools. Inquiries show that it is no uncommon thing for boys, and even for girls, to spend five or six hours nightly on home lessons. This cannot be good either for health or for education. The excessive nervous strain entailed reacts upon the intellectual no less than on the physical development of the pupils. The evil lies in the effort to attain a very high degree of efficiency in too wide a range of subjects. Only by the introduction of greater elasticity into the curricula of the most advanced classes can the tension be relieved.

With regard to the Leaving Certificate examinations the results show a slight improvement. Over 60,000 papers were examined this year; and the general impression made by them on those who took part in the revision is that, while advance in certain directions could be spoken of, they still manifest features of marked weakness in the results of the teaching of secondary subjects in Scotland.

Candidates do well or ill according to schools rather than as individuals, and on the whole the candidates from the state-aided schools appear to pass with a narrower margin than those from the higher class schools. To the slight fluctuations in the percentage of passes in the different grades and subjects, compared with the previous year, not much weight is attached. Taken all over, the lower English papers show distinct signs of improvement this year, although there is still much weakness apparent in the more important parts of the work. The worst feature of the examination is the lack of general intelligence and of power of composition still shown in the paraphrase and essay. In the higher-grade English, although there is little proof of marked excellence, yet a fair average is still maintained, and there has been decided improvement over a series of years. In the honours papers the result is once more disappointing in some respects.

Some severe strictures are passed with regard to the Latin papers. The features noted in previous years continue to reproduce themselves in curiously persistent fashion. Even of those papers presented by candidates for honours, it is said that the rendering of the prose passage set for composition was often very bald, and style non-existent. Sometimes it was not even grammatically accurate. In Greek the level of former years has been at least maintained.

In French there are not wanting signs of real progress. In lower grade the progress is particularly visible, while there is a slight improvement in honours. In commercial French improvement has also to be noted. In German the standard in lower and higher grade is maintained, while a beginning has been made in commercial German. In mathematics some improvement is apparent. The theory of arithmetic is weak and of algebra is not well understood. The book-work in geometry is well mastered. The examination in science exhibits a growth in popularity, while drawing, both in quality and in spirit, shows considerable improvement on that of last year.

It is possible that a very high standard has been set in the various examinations for the Leaving Certificates, and consequently this may account for the apparent defects. But strictness is more stimulating than laxity, and no doubt little objection needs therefore to be raised on this account.

THE LONG-DISTANCE SCHOOL JOURNEY.

EIGHT DAY EDUCATIONAL TRIPS FOR LONDON BOARD SCHOOL BOYS.

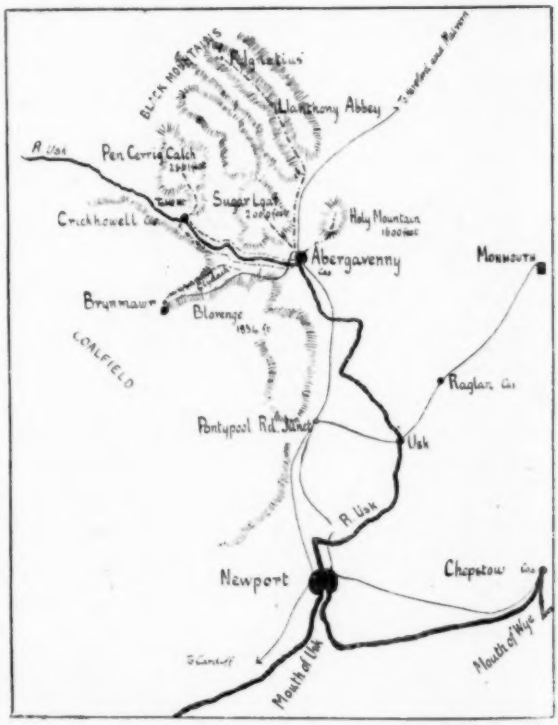
BY G. G. LEWIS.

HAVING outlined the preparations for a long-distance school journey, we now ask the reader to accompany the Bellenden Road boys on

A Trip to Abergavenny.

The forty-three juvenile tourists assemble at Peckham Rye station at 7 a.m. on the Saturday before Easter. Each boy's change of clothes, hammer and satchel, brush, comb, soap, towel, and slippers are packed in a grocer's empty, this being preferable to having a miscellaneous assortment of bags and boxes.

The worst part of the journey is getting across London, for which two hours are allowed. The Great Western Railway has kindly placed a corridor coach at our disposal, with lavatory accommodation. The luggage is stacked in one of these, and gives us no further concern till we reach our destination at night.



Page 2 of the guide book gives the time table for the day, page 4 a list of all the points likely to prove interesting *en route*, whilst opposite to it, on page 5, is a map of the whole railway journey. Attention is called not only to towns and their industries, but also to the exposures of

rocks, as shown in the railway cuttings; specially steep gradients, and their cause; and particularly to the connection between rocks and scenery, as evidenced in the outlines of hills, depth and slopes of valleys.

Photo by [*G. G. Lewis.*

LONDON BOYS IN WALES.

We arrive in Gloucester at midday. The organiser, with a small pioneer party, travelled down in advance two days before, and has enlisted the sympathy of the stationmaster, who kindly detaches our corridor coach, and shunts it into a siding, while we spend an hour or two in the city.

The boys are dismissed at the station, and told to explore the place by the aid of the map on page 7, the docks being "most specially tabu," as Kipling says. This turning out into a strange town is a fine exercise for the lads, which they keenly relish. Never once has a boy lost himself, or reported himself much after time at the appointed hour and rendezvous.

The first day is generally

Cathedral Day,

Worcester being taken on the way to Malvern, whilst Gloucester is passed when visiting Chepstow or Abergavenny. The lads meet us at the South Porch to-day, and during the hour some of them have succeeded in discovering the park, museum, market, New Inn, Robert Raikes's house, and Bishop Hooper's monument.

A few notes on the history of the cathedral, a plan, diagrams contrasting Norman and Gothic arches, occupy another page of the guide. The Dean has kindly given permission for us to be shown over at a very nominal fee. When possible we stay to afternoon service; but as we have to reach Abergavenny, time does not permit on this occasion.

The organiser has arranged for an early tea at a restaurant (6d. per head), lunch having been eaten in the train. And at 3.30 p.m. the party is in its own carriage once more, bowling along beside the Severn estuary, under the historic Forest of Dean, past picturesque Chepstow and busy Newport. We arrive at Abergavenny at 6.40 p.m., where a cart meets the train for our luggage, and we proceed to our headquarters, where a hot dinner awaits us in a large dining-room. The portioning out of the boys to the various rooms takes some time. Friends are allowed to sleep together if the combination is not likely to prove too dangerous, a monitor is made responsible for the order in each room, boxes are unpacked, and then they reassemble once more to make up accounts. This is an important feature of the outing. Four pages at the end of the guide are devoted to cash accounts, which are entered up and checked with cash in hand by a teacher each night. This is done with the twofold object of ensuring a wise distribution of the pocket-money over the eight days, and inculcating habits of carefulness and method in money matters. The receipt side often shows some interesting entries. Besides the 6d. cash prize each day for top boy in marks, there is a standard payment of 3d. per day for carrying a teacher's coat or camera. One boy with business instincts showed a daily "profit on sale of oranges." He would invest in threepenny-worth of oranges at seven for threepence, and retail them at a penny each when we reached the summit of a mountain.

Few boys sleep well the first night, and they are always ready to be up at five the next morning. Afterwards, difficulty is experienced in getting them down to breakfast at 8 a.m.

Sunday.

Knowing this, we are prepared to take them for a walk along the river at 5.30 a.m. The lads are particularly impressed with the cloud-capped mountains—a new sight to most of them—whilst the Usk running swiftly over its pebbly bed comes as a striking contrast to the smooth-flowing Thames.

After breakfast a parade is held to award marks for "cleanliness," before going to church. We have never yet had a parent ask for his son to go to a separate place of worship—though the request would, of course, be at once granted.

After dinner we set out to climb the Little Skyrrid, close at hand, and only 600 feet high. This affords a capital bird's eye view of the district, and enables us to get an idea of the position of the hills which dominate Abergavenny. The evening is devoted to writing letters home to anxious parents—the only letter some of them will get unless funds run low.

Monday—Waterfall Day.

We escape the Bank Holiday crowds which are pouring in from the hills, by taking train up the steep side of Blorenge to Brynmawr. Brynmawr is in WALES; and this gives a new thrill—the young tourists are in a foreign country. How pleased they are when they overhear a couple of colliers speaking in Welsh!

We would like to go down a coal-mine; but that is deemed too risky with our large party. We content ourselves with collecting beautiful plant remains from the shale on the coal tips, and endeavour to recognise them from the

FALLS OF THE CLYDACH.
(*By permission of "Focus."*)

sketches on pages 16 and 17 of our guide book, after which they are carefully wrapped in newspaper, and stowed away in our satchels. Page 14 gives in a nutshell the main facts concerned with the formation of coal, whilst another diagram shows its position in geological history.

The waterfalls are, however, the chief object of this day's excursion. The Clydach falls 1,000 feet in three or four

miles, and, cutting its way through shale, grit, limestone and sandstone, produces a different kind of fall in each case. A small tributary on the left presents a particularly instructive fall. A young Niagara dashes over a hard stratum at the top. Underneath, the soft shale has been washed away, so that the boys can get behind it. At the bottom it strikes on hard grit. The limestone further down the valley gives deep glens, down which we scramble gingerly. It is so dark that the photographs require ten minutes' exposure. Lower down still the Old Red Sandstone yields yet another kind of waterfall, with long, shelving cataracts.

The young students are encouraged to take notes and make sketches—a prize being offered for the best book by a friend of the school.

The guide book gives the briefest of notes, more detailed instruction being given on the spot.

Here are the notes on waterfalls:—

"Notice the great power of rivers in cutting back into the mountains. The sketch below shows—

"1. The slope of the rock when the Clydach first attacked the hillside — — — —

"2. The present slope ————————

"3. The slope it will cut for itself in the future —·—·—·

"Waterfalls are usually caused by the river running over

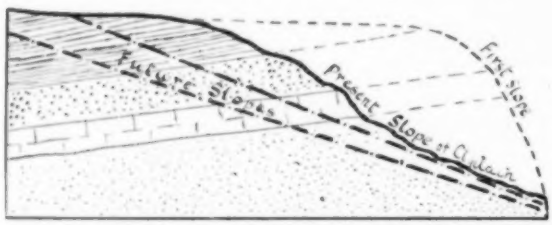
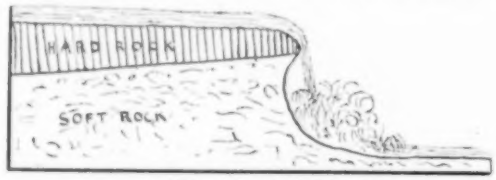


DIAGRAM SHOWING SUCCESSIVE SLOPES OF RIVER BED.

very hard rock which has softer rock underneath. The hard rock resists denudation; the soft rock gets washed away."



FORMATION OF A WATERFALL.

Half-way down the gorge we experience the only accident of the week. Two boys slip on the smooth stones, and get a ducking. Here is seen the advantage of having at least one other teacher present. The lads are taken off to a cottage, a dear old soul brings out a couple of blankets, gets them a hot cup of coffee, and dries their clothes. They follow on an hour or two later with the teacher who remains behind.

Some of the boys and two of the teachers have cameras. Photographs are taken of the boys marching down the gorge—the Falls—the Devil's Bridge—boys eating lunch—the "patients" huddled before the fire in their blankets—of anything likely to be of interest as a lantern slide later on.

On these days we take a light lunch, and have a good hot dinner when we get in at six or seven in the evening—finishing up with an impromptu concert, charades, or lantern.

(*To be continued.*)

CO-OPERATION IN SCHOOLS.

THERE has lately been instituted an annual conference of the head-teachers of the three departments of an elementary school. They discuss difficulties that arise in the working of the school, and endeavour to co-ordinate the work as far as possible. Much benefit is derived from these conferences, and an extension of the idea is the purpose of this article.

Once a quarter there should be a meeting of the combined staffs of the three departments. At these meetings prepared papers could be read. Many ideas come to teachers which, if discussed and thought over, would lead to many discoveries in the science of pedagogics. These ideas come; they go; they are pearls allowed to roll back again to the vast regions of subliminal thought. If they were embodied in a short paper, and discussed in friendly fashion among a number of friends, considerable augmentation of the professional stock-in-trade would doubtless ensue. Then there would be many detached ideas which could be thrown off impromptu at these meetings—ideas perhaps of no use to the creator, but of great value to others. Again, many difficulties arise and bother every teacher, no matter how efficient. The whole collective wisdom of the combined staffs would bear upon these little points and vanquish them. Union is strength.

Every one will agree that such meetings would be of much benefit, and it is for some enterprising spirit to start them.

Another little innovation which would prove of much value would be a system of visits. At stated periods the teacher of Standard I. boys should be allowed to spend the whole session in Standard I. girls, and, of course, have the honour of a return visit from the lady. During these visits many tips would be picked up, questions would be asked, and friendly criticism be freely given. By this means a better co-ordination of work would take place, and the impetus of a friendly rivalry would lead to a much greater interest being taken in the work. Of course, this principle would extend over the whole of the school.

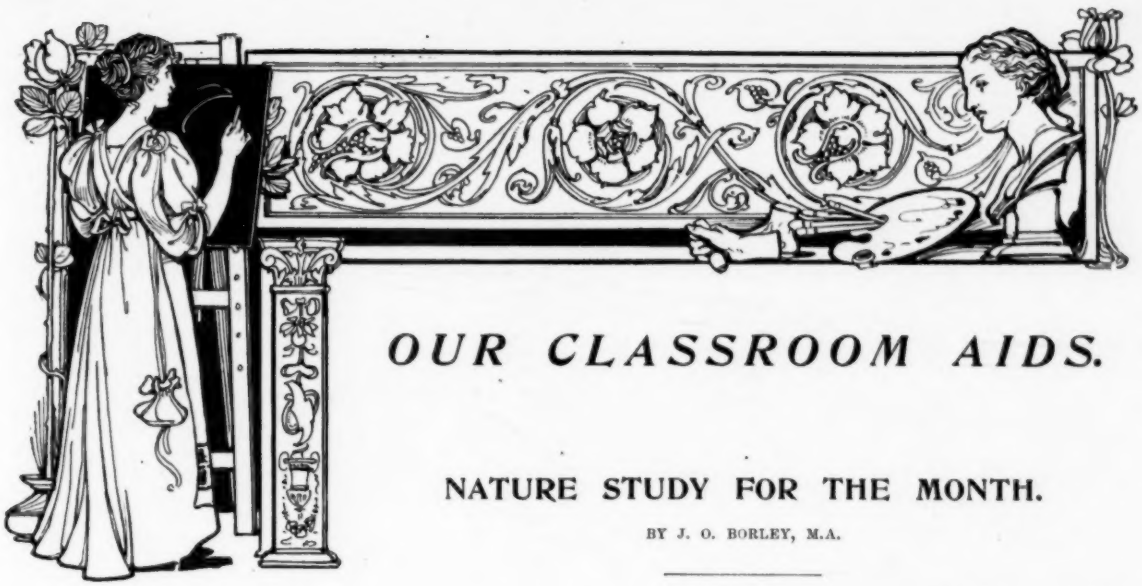
Much more harmless criticism is required in schools. Teachers are apt to get into bad grooves of work, to become mechanical, until suddenly aroused by the trenchant criticism of an inspector. It is far better to be criticised unmercifully by the friendly critic, for then one can mend one's way before the arrival of the feared one. Again comes in the co-operation of the "heads." If once a quarter each "head" paid a surprise visit to the other departments, and for the nonce acted as an inspector, it would be of untold benefit to the assistants. Of course, the stiffer the criticism the better, and as this would be delivered orally to the assistant *only*, it would be welcomed. In this way the teachers would get a most useful pull-up, and would be full of thanks a little later on.

Another way in which co-operation could be practised is in the utilisation of the *appareil d'enseignement*. In a school there are maps, diagrams, pictures, apparatus, and museum objects. These are divided among the three departments, and one department practically never uses the stock of the other. The advantage of "reciprocity" in teaching apparatus would be an enormous gain in the educative work of the school. This requires no elaborate explanation; it is obvious.

But then at once the trouble it would cause to the already overworked staff offers a great objection to the adopting of this plan. To that we say, if for ten minutes twice a week, from twelve to ten minutes past, a teacher was placed on duty in each of the departments, and if each teacher "took turns" week by week, the amount of time would be so small for each individual teacher that the undoubted great advantage quashes this objection at once. "But the returning of the objects borrowed will cause so much friction," will be another objection raised. To prevent this a rule could be made and strictly observed that all articles borrowed must be returned the same day, immediately at the end of the afternoon session. The putting away of these objects could easily be done in five minutes, with the help of one or two senior scholars.

To make this plan of the utmost value a list should be compiled of all pictures, objects, etc., which are of value educationally, and a copy of this list should be placed in the hands of each teacher. It should be known off by heart, so that at once a teacher would know if a required illustration or object is in the school building, and then she could make a note to obtain it at the first opportunity.

These suggestions undoubtedly entail extra labour on the teachers, but the gain to the school and to themselves will be so enormous that the necessary time will be cheerfully given when the advantages are clearly realised.



OUR CLASSROOM AIDS.

NATURE STUDY FOR THE MONTH.

BY J. O. BORLEY, M.A.

Crabs.

TO study a crab without previous study of the lobster would be much like trying to read a cipher message without the key; and to study the lobster without following work on the crab would be to miss a very fine and easily tackled case of specialisation and development. The crab tribe, like all classes of animals, can, of course, be worked at in two ways. Neglecting minor differences, we can take a specimen which gives on the whole a true racial average, and compare it with the other animal classes of which we have some knowledge; or, neglecting such matters, we can note the marvellous diversity of sub-tribes among themselves—diversity permitting sizes from one-sixth of an inch to some yard or more in width, and habitation from very deep seas to hillsides far above sea-level. Both come in the end to the same—the study of specialisation. We must confine ourselves mainly to the first.

Our material is, we will suppose, gathered already. It consists at least of specimens of some common crab—*Carcinus mænas*, the green and ubiquitous shore crab, or *Cancer pagurus*, the edible crab. Let us hope these specimens are numerous enough to go round a class arranged in pairs. If in no other way, crabs can always be obtained by the prosaic method of purchase at a fishmonger's, and such crabs will answer all our purposes, in spite of the boiling.

First, for general appearances, we will during this description keep to *Cancer*, with occasional discursions. Let the crab lie naturally, and note its curious inverted dishlike or pie-crustlike shape, crenellated at the edge. Let the children discover as many likenesses to and differences from a lobster as they can. Obviously the likenesses are in the material of the shell, the eyes, the claws and legs just seen beyond the shell's margin, and the feelers or antennæ in front. The differences are the apparent absence of the tail, the shortness of antennæ, and the great breadth and sharp edge of the carapace or shell.

Now turn the creature over. The class will now see more obvious proof of relationship to the lobster. The centre of the body is the point of a triangle, directed backward, and crossed by lines marking it into successive pieces. Insert a knife blade under the apex of the triangle and gently raise it. It is a movable flap—in fact, the previously missing tail—and the cross lines, continued round its under surface, divide it into segments. Traces of segmentation are seen also at the bases of the legs, in the form of transverse lines on the body, especially in *Carcinus*. It is a good exercise to sketch the under surface, as it will call attention to many details that would otherwise need pointing out. The copying will aid the observation, while the observation will be preserved by the copy.

Let us be sure, therefore, of the accurate copy of the following details:—First, that the tail has its fringe of stiff hair and its accurate segmentation. Second, that the legs are correct in number, number of joints, and position. Third, that the panel-like plates are put in, in front of the tail. Lastly, that notice is taken of the deep cavities in which the eyes and the antennæ are sunk and protected. With regard to the position of the legs, a rough indication of their normal position may be attempted on one side, say, by a single line for each leg. The claws and next pair point forward, the rest more and more back. The number of legs gives the name to the class to which crabs belong—the Decapoda.

Any one who has examined a crab carefully even so far will probably have been struck by a feature of its organisation less remarkable than its inturned tail and broad shape, yet also less familiar to most of us—namely, its great compactness. Fold the legs and claws in their natural flexed or contracted condition, and a crab is magnificently compact. Tail is under, legs are under, claws are under, eyes and antennæ scarcely protrude. All is under the shelter of the carapace or broad upper surface, which seems drawn out for the purpose. This is a great crab character, this economy of space, and within the space occupied there is hardly the pettiest mark which has not its use. The very spines along the edge of the shell have a use in some crabs, as we shall see.

And this brings us to another general crab feature. Though like a lobster, he is more developed. Besides the above evidence, one has for this only to compare his claw limbs with those of a crayfish or lobster. Notice the articulations of the joints. They are far more definite in the crab. A little knob from the last segment, or rather an opposite pair of knobs, projects in each case into the next. They make an excellent hinge, strong by the single direction of its motion; and joint after joint the plane of these hinges alters, giving the limb perfect play and perfect power of tucking and folding in. The advantage is obvious: the great chelæ or claws protect the part of the body above them, which needs only a thin wall.

Let us proceed with this study of compactness, then notice its meaning and effect.

We have noted that the tail can be raised. If we raise it, we find its state different in crabs with narrow tails from that in those with wider ones. The former are males, the latter females. The former have but a couple of pair of appendages below the tail, and those but poor ones; but in the latter we find many large appendages of surprising length, fringed with hairs. The reason of this is that the eggs are carried about adhering to these hairs until hatched. A crab thus can protect its eggs better than a lobster, which carries its eggs similarly.

To turn now to the "panels" in the front of the under surface. It will be well to provide ourselves with forceps, a pair of strong scissors, and a sharp penknife, as there will

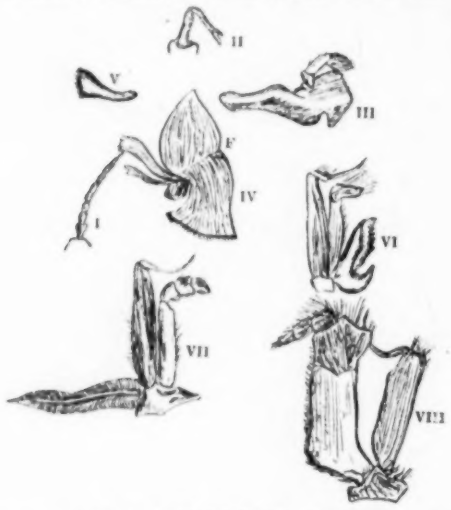


FIG. 1.—HEAD APPENDAGES OF CANCER.
I, II, IV, V, VIII are from animal's left; III (the Mandibles), VI, VII, from the right. F is the gill chamber's fan.

now be a little cutting to do. Force the panels gently apart in their own plane. They will open like folding doors, and reveal the mouth parts—veritably compactness triumphant. Cut one "panel" free at its base, and lay it on a long strip of paper, parting the parallel pieces, as in Fig. 1, VIII, to see its whole structure. In the following work remove only one side's appendages at a time, and wash in water, say, using throughout a good sized pie-dish of water. It is perfectly easy to follow out all the mouth parts and gills, if one is careful never to cut until obliged, to go slowly, and never cut at random. A single hasty removal may completely alter the appearance of remaining parts and spoil the specimen.

Having now removed the panels, work the blade of the knife down carefully behind the parallel rods it leaves exposed, then pressing the forceps well down to the base, pull at them, cutting round the base with the knife. The result should be to bring out both rods and an attached gill (Fig. 1, VII). If not successful, try the other side more warily. Proceed with the next layer in the same way: no gill is found (Fig. 1, VI). The powerful mandibles are now exposed. Cut firmly at the base of one and remove it (Fig. 1, III).

Between the mandibles and the first three pairs removed really lie two other appendages. That immediately behind the jaws is important, as it bears the paddle driving the water forwards out of the gill chamber; the entrance is behind. It is best to find the paddle first by cutting from the front margin of the gill chamber (level with front of "panel") parallel to the edge of shell, and breaking up thus the floor of the gill chamber. A leathery fan is quite in the front of the chamber. Seize it at the root and drag it out. The mouth part comes with it, and leaves the sole remaining mouth part exposed. The latter is of use in mastication, but the former is far too delicate. It may prevent the escape of food particles. For comparison I have sketched all these appendages.

Lastly, with strong scissors remove the whole of the gill chamber floor. This was unnecessary in the crayfish. The crab's gills are better protected therefore. Notice the great space given by the arching of the chambers, and draw out one of the gills to show its arrangement, curved back to the roof of the cavity. An interesting use is made of this cavity in the great palm-climbing robber crab of the West Indies. As this crab lives on land, except for a short yearly visit to the sea at the breeding season, it is necessarily an air breather, and it has developed veritable lungs. The upper part of the gill chamber forms this lung. It is lined with spongy, thin-walled skin, raised into frills and puckers to increase its surface, and is partitioned off from the lower part, which contains the much reduced gills, by a fold of skin from the body wall, which nearly meets the shell. The lung-skin, as in ourselves, is kept moist: a small quantity of water lasts a long time in the service.

It is now time to make some rough attempt at summing up the meaning of the change from lobster-like creature to crab. It will be remembered that the former lurk in crevices in rocks: the crab does the same, but does it more perfectly. His economy of space helps him. It is not, however, without its inconvenient side, to succeed in concealment. The power of escape decayed, probably, *pari passu* with the flattening down to a lenticular mass, for the flap of the tail was no longer possible, since the tail necessarily decreased as part of the change. Again, the difficulty of shell casting becomes even increased. The crab's carapace splits very much along the line at the outer edge of the gill chamber, leaving the rim of the shell with the upper part, and this widening zone of weakness the crab must increase till he can creep out defenceless. The first disadvantage is met by increase of pugnacity, which most of us have noticed exists to a comical extent in small crabs. The second is in *Cancer* partly met in a curious way. Crabs generally live in pairs, and it is found that both hardly ever lose their shells together; neither is therefore left unprotected.

One does not, of course, by the above mean to give more than the vaguest ideas of the essential differences of condition of the two tribes contrasted. Yet that, possibly on account of the helpless stage, something in crab nature does turn towards shelter is borne out by wider facts. Some small crabs, for instance, choose to live in the shells of mussels and allied molluscs, without any evidence whatever of parasitism existing. They have been found sheltering in the burrows of sea-worms (staying so long as to grow too large to emerge), and in the empty capsules of whelks' eggs. Lastly, and most numerous, they take up their abode in the empty shells of whelks or other spiral shells (Figs. 2 and 3).

Those that thus simplify sheltering by carrying the shelter with them are called hermit crabs. It is well worth procuring at least one to show a class. They are often found in

FIG. 2.—HERMIT CRAB WITHDRAWN FROM SHELL OF WHELK.
P, the soft body. A_1, A_2, A_3, A_4, appendages used for clinging in shell.

winkle shells. Much might be written of these curious crabs, whose bodies are quite soft, the shell providing the protection needed. The briefest summary must now suffice.

The body is soft, tapering, somewhat spiral to fit the shell, shows in front some signs of segmentation, and has small

remnants of the appendages of the body (or, as we have loosely called it, tail), with which it can cling so powerfully to the shell that it is said to allow the body to be torn rather than let itself be removed. The softness and twist of the body is acquired, since crabs, similar in all other respects, but not inhabiting shells, show neither feature.

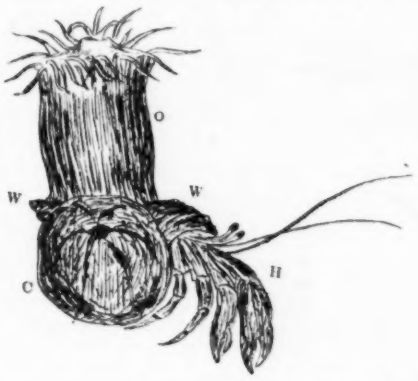


FIG. 3.—HERMIT CRAB (H) CRAWLING IN A WHELK SHELL (W), on which an open (O) and a closed (C) anemone are attached.

The claws are unequally developed, usually the left being larger, and together they can be placed across the door of the abode in a way to make it impregnable. They are very pugnacious, ejecting and eating a rival if they require his shell, and can catch him unawares. Sometimes, indeed, they will do this only to find the exchange a bad one, and reverse it.

They must, of course, change their shell frequently, owing to growth, and they will often spend many hours before making a decision as to a change. A new shell being found, its opening is brought close to that of the other, and the new tenant whisks in. But this is only the beginning. The shell is allowed to slip nearly off, then pulled rapidly on again. The change is reversed and repeated. He tries the favourite manœuvre of so drawing in as to let the shell drop as if empty on the bottom; and he runs rapidly, with the alternative dwelling still safely clutched. Strangest of all, in some ways, is the fact that all this cautious procedure requires no length of experience to develop. The young crabs carry it out as soon as shell or even empty tobacco pipe is available.

Two other curious cases of protection must be noticed, one involuntary, the other of fixed design. The first is the curious association of certain sea anemones with hermit crabs. It seems the will—one is almost obliged to use that term, strange as it seems—of the plantlike creature to attach itself to the hermit's abode. One specimen slowly changed its position three times in an aquarium till a hermit crab carried his shell into a crevice below, when it quietly let itself fall on the shell and fixed itself. Possibly the stinging powers of the anemone protect the crab, and the motion of the crab gives the guest better opportunities of feeding. At all events, species for species, the queer set of associations are kept up, never the wrong anemone to the wrong crab, but each after his kind. In the case of certain sponges the process goes further. The whole shell is absorbed by the sponge, and the hermit lives in the sponge.

The last case is that of the spider crabs. These live, as a rule, in fairly deep water. *Maia* is one very common in the south of England and in the Mediterranean. These crabs have pear-shaped or triangular bodies, thin shelled, and covered with recurved hooklike hairs. The crab when dredged up is always partly or wholly covered with small pieces of seaweed or anemones. It was long known that these rendered him inconspicuous. It has been proved in addition, however, that he not only deliberately nips off the living weed and himself fastens the pieces deftly on the hairs, but that he changes the whole suit as often as he is put among weed of a different colour; and, lastly, that if any attached portion seems languishing, and declines to affix itself amicably, it is removed and carried to the mouth, apparently to supply it with an adhesive secretion of the mouth. Sometimes this is patiently repeated as many as three times, and new spots on the carapace sought out for resting-places.

Here this brief notice must stop. It may not be useless to give a reminder that the Kensington Natural History Museum has some very fine land crabs, including the crab mentioned above, the inspection of which well repays a visit.

NATURE KNOWLEDGE.

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LESSONS ON FOODS: THE GLUCOSES AND FERMENTATION.

THE second division of the sugars contains those less familiar forms known as glucose. This term includes natural sugars, such as those found in honey and in all fruits, as well as the artificial sugars, both solid and liquid, manufactured generally from starch, wheat, maize, or potato, and so called starch sugar. The increasing use of this artificial sugar in the brewing, confectionery, and preserve trades renders it of some importance commercially, while its interest from a dietetic or physiological standpoint is of the very greatest, since it is into a glucose that all carbohydrate foods are converted in digestion.

Samples of solid and liquid glucose may be had for the asking at any brewery; honey and treacle will serve for most experiments demanding fermentation; while any fruit jelly will give an abundance of glucose, obtained in this case by "inverting" cane-sugar. The process of inverting was described in the September number of the *Practical Teacher*. The following easy chemical test will serve to detect any glucose, either alone or in presence of cane-sugar. Pound together in a mortar some cane-sugar and caustic soda chips: no change occurs. Repeat the experiment with glucose for the sugar, and a deep brown colour forms. The sugar and caustic soda may also be dissolved in as little water as possible, then heated, when the brown colour appears.

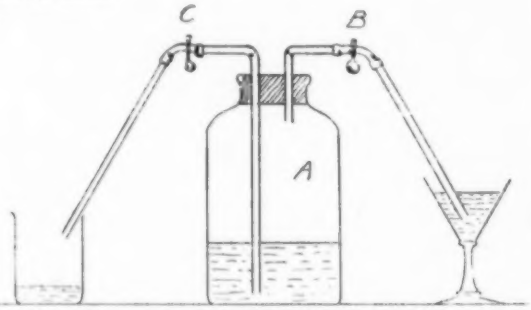
Dextrose, or grape-sugar, is a typical glucose. It forms from 10 to 15 per cent. of grapes, and is present in almost all fruits, even such acid fruits as plums containing from 1 to 4 per cent. Like common sugar it dissolves easily in water, but its sweetening power is only two-fifths that of cane-sugar, hence the apparent loss of sugar in making jam, especially with acid fruits. When heated it loses water, and passes into caramel or burnt-sugar. Dextrose was formerly made from grapes, but it is now made from maize or potato starch, this artificial dextrose being often called starch-sugar. The conversion is simple and interesting as a class experiment.

Take some laundry starch, add cold water so as to form a fluid cream, then pour it gently into boiling dilute sulphuric acid, stirring all the time. The strength of acid should not exceed 5 per cent.; indeed 0·5 per cent. acid gives a more regular conversion, but it requires more time. By increasing the temperature conversion is also hastened, but here there is danger of the liquid becoming brown by formation of caramel. When a sample of the liquid no longer gives the well-known blue colour with iodine, the conversion is complete; more roughly, this may be gauged by the eye, all milkiness having disappeared. About ten minutes will be required with 5 per cent. acid. The next step is the removal of the acid. This is effected by adding a cream of chalk and water till the sour taste disappears, or, better, till blue litmus paper dipped in the liquid no longer turns red. Chalk (or lime) forms with sulphuric acid an insoluble sulphate of lime, which settles to the bottom as a white sediment, leaving a glucose solution above; this latter is carefully decanted, and, if necessary, filtered through bone charcoal to remove any colouring matter due to caramelisation. By evaporating the solution, it may be concentrated to

a syrup. In order to obtain solid glucose a vacuum pan is required, since further heating in an open dish favours the production of caramel. Ordinary commercial glucose contains 70 per cent. of dextrose, from 5 to 10 of dextrin, and from 10 to 20 of water, along with smaller quantities of malt-sugar, cellulose, "ash," etc.

Honey is practically a mixture of dextrose and levulose, and these may be separated easily enough. Stir up some pure honey with its own bulk of alcohol, using rectified spirits of wine. Shake thoroughly, then allow to settle, and decant the liquid. Add more alcohol to the sediment and repeat the washing; and so for, say, four times. This washing removes levulose, which is more soluble in alcohol than dextrose, so that the sediment consists finally of dextrose alone.

The leading property of glucose is the ease with which it may be fermented by yeast; and this is, of course, the reason why it is so extensively used in brewing. Take some honey or treacle—or common syrup if those are not to be had—mix with lukewarm water to form a liquid like beer, add a teaspoonful of yeast to a cupful of liquid, put the whole into a bottle, cork well, and keep in a warm place, such as a kitchen press. Fermentation proceeds briskly; the yeast plant feeds on the sugar, converting some of it into alcohol and carbonic acid gas, and this latter accumulates so quickly that in twenty-four hours the cork is generally blown out of the bottle. After a day or two the process stops, since the yeast is killed by the alcohol produced. The liquid is now a beer, containing from 2 to 5 per cent. of alcohol, a large amount of unaltered sugars, and it is, besides, saturated with carbonic acid gas, so that it is highly aërated, showing a "head" and effervescing when drawn. For class purposes the following apparatus is very handy:—Take a stout bottle to hold the fermenting liquid, fill it half full only, and close it by an india-rubber stopper with two holes. Through these pass glass tubes bent at right angles, one tube reaching to near the bottom, the other reaching just to the neck. These may be connected on the outside, by means of an inch of india-rubber tubing, to a pair of longer straight tubes for delivery purposes. A spring pinchcock or clip on the india-rubber connections closes all exit till the time arrives. On opening the pinchcock on the deep tube the beer is drawn off as in a gasogene—being, in fact, expelled by the pressure of the imprisoned gas. The short tube in like manner gives off carbonic acid gas, which may be delivered into some lime-water for identification by the usual test. The figure shows the apparatus.



Apparatus for Fermentation.
A, Fermentation bottle with sugar solution. B, Delivery tube for gas. C, Delivery tube for liquor.

Yeast is able to ferment maltose, and even cane-sugar, but with greater difficulty; hence the desirability of "inverting" cane-sugar by any of the methods mentioned. The process is continuous and complicated, several intermediate stages being recognised; but it may be summed up by saying that glucose is split up into alcohol and carbonic acid gas, and the fermentation stops when the percentage of alcohol rises sufficiently high to become of poisonous strength to the yeast.

The fermentation of wine is similar, but the liquid employed is grape juice, and the special ferment, wine yeast, is not added by the manufacturer but allowed to work spontaneously, making the process slower. "Invert sugar" is often added to wines of low sweetness so as to produce a sparkling wine. In this case a second fermentation goes on after the wine has been bottled, so that the liquid is effervescent like beer.

Other examples of fermentation, which will come up later on, are the lactic fermentation, seen in the souring of milk, and the acetic fermentation, which forms vinegar out of beer and wines of low alcoholic strength.

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

PETROLEUM.

PETROLEUM (naphtha or rock-oil) has been known to civilised man from the very earliest periods. The springs of Zacynthus were mentioned by Herodotus; the fountains of Hit were held in high esteem by the Arabs and Persians; Pliny described the oil of Agrigentum, which, under the name of "Sicilian oil," was used in the lamps of his day; and the Chinese valued their petroleum springs long ages ago. Marco Polo and other overland travellers described the wells and the fire temple at Baku, and petroleum in North America was mentioned by a Franciscan missionary as early as 1629. It is, however, within recent years that the use of petroleum has become practically universal. It was probably the extraordinary abundance of petroleum in the United States that drew attention to the valuable properties of the product, and raised it to an object of the highest commercial importance.

About the middle of the last century oil was discovered near Alfreton, in Derbyshire, and illuminating and other oils were manufactured from it; and at Bathgate, in Scotland, similar operations were carried on. Oil had frequently been found in the United States when searching for brine, and the successful operations in England and Scotland attracted American attention, and by 1855 refined petroleum could be obtained at various places. The supply, however, was too small to afford a good foundation for even a local trade.

Nowadays the demand for petroleum is so great that it is worked wherever it is found in sufficiently paying quantities. The chief sources of supply, with output for 1901, are—

	Gallons.		Gallons.
Russia	2,781,000,000	Japan	30,000,000
United States	2,127,000,000	Canada	25,000,000
Austria	88,000,000	Java and Sumatra	15,000,000
Roumania	62,000,000	Germany	13,000,000
India	38,000,000		

United States.—Until comparatively recent years the petroleum industry was almost peculiar to the United States. Until 1857 this valuable natural product was known as "Seneca oil," and was used chiefly as embrocation for bruises, etc. The annual output at this time was about sixteen barrels. Then came the discovery of its illuminating powers, and the first well was sunk at Titusville, in Pennsylvania, in 1859. For a long period all the wells of more than local importance were confined to this state. The industry rapidly grew to immense proportions, and by 1873 nearly eight million barrels of forty gallons each were produced. By 1883 the wells of Pennsylvania alone numbered quite 17,000, with an average daily output of about four barrels each. At the present time the annual yield is not less than 30,000,000 barrels.

The methods of production are common to nearly all oil-fields. Wells are usually sunk, and the crude oil is stored in huge reservoirs. Long conduit pipes convey the oil to the refineries, sometimes hundreds of miles distant. Boring operations are not always necessary, for the oil bursts out of its own accord, and is appropriately called a "gusher." Texas afforded such an example in 1900. The output was 1,500,000 barrels annually, but the newly discovered source gave an additional 60,000 barrels per day. Huge fortunes have been quickly amassed out of "gushers," but the supply sometimes ceases as quickly as it appeared.

Petroleum towns, from the very nature of the pervading

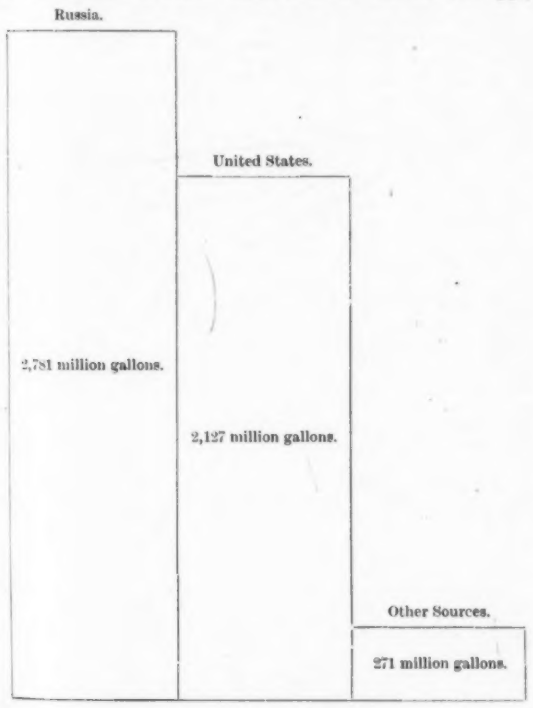
industry, are not inviting places of residence, and the danger from fire is a very real and ever present one.

Russia.—The petroleum industry of Russia is chiefly centred in Baku, although other areas yielded about 500,000 tons of crude oil in 1900. Baku was wrested from Persia by Peter the Great in 1722, and has proved an asset of untold value. In 1900 the total output of the district of petroleum in various forms was—

	Tons.
Illuminating oil	2,101,000
Lubricating oil	218,000
Various naphtha products	23,000
Residuum	4,706,000
	7,048,000

The Russian output now exceeds that of the United States, which held the premier position for a very long period.

The Standard Oil Trust.—The world of commerce can show no greater achievement in organisation than this huge combination of interests. The possession of the oil-fields of the United States was the natural and most important part of the Trust's business, but, to aid in the distribution of the oil, it obtained a controlling influence in the means of transit, and the American railways are largely under its domination. Oil-carts are familiar in the streets of the towns of the United Kingdom; there are oil-cars for transport by rail; there are fleets of tank steamers carrying oil across the oceans; there are oil-caravans in Asia. More than half the world's supply



SUPPLY OF PETROLEUM.

of illuminating oil is produced and retailed by this gigantic Trust. There is also a huge trade in by-products, such as gasoline, vaseline, naphtha, lubricating oils, etc. The oil trade of Western Europe is controlled almost entirely by the Standard Oil Trust.

In France it is compulsory to refine the oil in that country, but it makes little difference to the Trust, for the refining company is an integral part of the great organisation. Only in the East has the Trust to meet real competition. Burma, Dutch East Indies, Java, and Sumatra possess large supplies of oil. For a long time the Trust endeavoured to get concessions from the Indian Government, but without success. The Dutch Government too exercises particular watchfulness in the matter of concessions.

The Trust's vast interests may be gauged by the capital invested, which amounts to £20,000,000. Last year a dividend of 48 per cent. was paid, which amounted to £9,600,000. The head of the Trust recently stated that they "enabled America to utilise the bounty which its land poured forth, and to furnish the world with the best and cheapest light ever known, receiving in return therefor from foreign lands nearly $50,000,000 per year, most of which is distributed in payment of American labour."

Uses of Petroleum.—The value of petroleum for lighting purposes is too well known to need comment, and many of the by-products are in universal demand; but it will probably become far more valuable as a fuel in the future. Engineers have long discussed the possibilities of crude oil as fuel for engines of all kinds. It is strange that liquid fuel has not been more widely used. It produces more steam than coal, weight for weight; the laboriousness of stoking is very largely discounted; and engines can be constructed to use either coal or oil, or a combination of both. For many years the locomotives of Southern Russia have burned oil, and the Southern Pacific Railway Company of the United States possesses a large number of liquid burners. In England, in 1886, the Great Eastern Railway Company commenced experiments in this direction, and each year sees a steady increase in their oil burners. With railway companies the question resolves itself into one of economy only. The British Admiralty is also experimenting with liquid fuel for gunboats, and although no definite report has yet been issued, it is practically certain that the trials have been sufficiently successful to at least warrant their continuance.

The exhaustion of the world's coalfields is a matter that need cause but few misgivings so long as a supply of petroleum is available. Large as the output is, there are vast regions still untapped to add to the comfort and the wealth of millions yet unborn.

NOTES OF A LESSON ON THE DISPERSAL OF SEEDS.

1. Refer to the fact that a plant obtains part of its food from the soil in which it grows. Thus wheat, barley, and oats take silica from the soil; peas, beans, and clover take lime; and turnips and potatoes take potash.

2. Lead the children to see, therefore, that the same kind of plant cannot, as a rule, be grown successfully year after year on the same plot of ground. Thus show that when a plant drops its seeds it is desirable that the seeds should be carried some distance from the parent plant, so that the young plants may grow in soil which has not lost the ingredients necessary for their support.

3. Tell the children that this dispersal of seeds is accomplished in various ways.

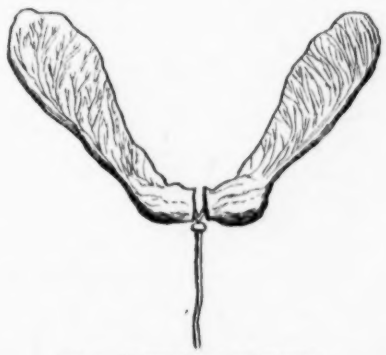


Fig. 1.—Winged Seeds of Sycamore.

(1.) **Dispersal by the Wind.**—(*a*) Show the children some of the *winged seeds* of the pine, ash, sycamore, elm, or birch (Figs. 1 and 2).

Take two of these seeds, and from one of them remove the

wing. Then hold the seeds at some distance from the ground, and release them at the same instant. The children will see that the seed from which the wing has been removed will reach the ground first. The winged seed, having a greater surface, will meet with more opposition from the air, and will consequently descend more slowly. When this winged seed is falling from a tree, there is plenty of time for the wind to act upon it and blow it to a great distance.

Tell the children that winged seeds are found on trees. Lead them to see that if winged seeds were found on low plants they would not be scattered far from the parent plant, as they would have but a short distance to fall, and the wind would act upon them for a very short time.

(*b*) The seeds of such trees as the willow and the poplar are surrounded by *tufts of hair* (Fig. 3), and these are also dispersed by means of the wind.

(*c*) The seeds of such plants as the dandelion (Fig. 4),

Fig. 2.—Winged Seed of Ash.

Fig. 3.—Seed of Willow.

Fig. 4.—Seeds of Dandelion.

groundsel, and thistle have attached to them a light downy structure which acts as a parachute. These seeds are known as *plumed seeds*.

(2.) **Dispersal by clinging to Animals.**—Tell the children that some seeds have hooks attached to them. Show the seed of the burdock or the teasel (Fig 5). Tell the children that these seeds become attached to the wool or hair of animals by means of the hooks, and are thus carried to places situated far from the place where they became attached to the animals.

Tell the children that these hooked seeds are found on low plants. Lead them to see that hooked seeds would be as much out of place on high trees as winged seeds would be on low plants.

Burdock.—Hooked seeds ("burrs") can be seen on the burdock, a plant with pink flower-heads something like a thistle.

Teasel.—When the seeds of the teasel are ready to be

Fig. 5.—Teasel.

Fig. 6.—Balsam scattering Seed.

scattered, the hooks become entangled in the wool and hair of animals, and are thus carried to great distances.

Tell the children that the teasel is used by cloth manufacturers to tease woven cloth—that is, to scratch the surface and raise the hairs ("nap" or "pile"). About twenty millions are imported for this purpose yearly.

(3.) **Explosive Fruits.**—(*a*) Tell the children that the seed-pod of the balsam (Fig. 6), which is found wild in some parts of England, is very sensitive when ripe. When it is ripe it bursts open and throws its seeds out. If possible, obtain a ripe seed-pod of the balsam, and allow one of the children to touch it. It will quickly curl up, scattering its

Fig. 7.—Pod of Broom (unopened).

Fig. 8.—Pod of Broom scattering Seed.

seeds as it does so (Fig. 6). Because of this action it has been called "Touch-me-not."

(*b*) Show also pods of the broom. Tell the children that these open violently, and in so doing throw the seeds to a great distance (Figs. 7 and 8).

(4.) **Eatable Fruits.**—Many seeds are enclosed in eatable fruits, such as cherries and plums. Much of this fruit is carried off by birds. After the eatable part has been swallowed by the birds the seeds are dropped.

HISTORY DAY BY DAY.

October.

1st. *Death of Lord Shaftesbury, 1885.*—Born in 1801, he held office under both Wellington and Peel, but he devoted himself chiefly to social questions, such as the employment of women and children in factories. His later years were entirely given up to works of philanthropy. He instituted the Shoe-Black Brigade and founded the Ragged School Union.

2nd. *André hanged, 1780.*—During the War of Independence, André rose from the ranks and obtained a major's commission. He conducted negotiations with Arnold for the betrayal of West Point, but being discovered in disguise he was arrested and hanged as a spy. The event roused considerable feeling in England, and his remains were interred in Westminster Abbey.

3rd. *Treaty of Limerick, 1691.*—Twenty thousand men under Sarsfield, a brave and skilful officer, withdrew to Limerick after the defeat on the Boyne, and held the town in spite of all William's efforts to capture it. When Marlborough assumed command, Sarsfield was compelled to make terms. He and his troops were allowed to take passage to France, and the city was promised the same privileges that it had enjoyed under Charles. The violation of the latter part has earned for Limerick the title of "The City of the Broken Treaty."

4th. *Marquis of Ripon born, 1827.*—Entered Parliament 1850; was twice Secretary for War and twice Secretary for India; Viceroy of India, 1880–4; First Lord of the Admiralty, 1886, and Colonial Secretary, 1892.

5th. *First English Bible, 1535.*—This was Tyndale's version, revised and corrected by Miles Coverdale. It was published under the patronage of Henry the Eighth, who ordered a copy to be laid in the chancel of every church "for every man that will to look and read there."

6th. *Death of Tyndale, 1536.*—Having determined to translate the Bible into English, he considered it expedient to retire to Hamburg, and later to Worms. He was arrested at Antwerp, and after a year's imprisonment suffered death at the stake.

7th. *Treaty of Aix-la-Chapelle, 1748.*—By this treaty each country undertook to restore all conquests made during the war, thus not a single point was gained on either side after a fierce struggle for eight years.

The Clontarf Meeting prohibited, 1843.—This meeting had been called for 8th October by the Repeal Association "to accomplish alterations in the laws and constitutions of the realm by intimidation and the demonstration of physical force."

8th. *The Clontarf Meeting, 1843.*—It was a critical moment for the Government, for if it were necessary to disperse the meeting by means of the military the consequences would be terrible. Such was the power, however, of O'Connell that when he declared the proclamation must be obeyed the people quietly dispersed. This, however, destroyed the nation's faith in him, and from that time his power declined.

The Reform Bill rejected by the House of Lords, 1831.

9th. *The Ultimatum, 1899.*—The Boer Government announced that unless the British troops were withdrawn from the frontier within three days, hostilities would commence.

10th. *Fiji annexed, 1874.*—The Fiji Islands were ceded by their chiefs to the British Crown, and formally annexed by Sir Hercules Robinson.

11th. *Camperdown, 1797.*—The victory of St. Vincent (14th February) had not succeeded in crushing the naval combination against England; for although the Spaniards were rendered powerless, the Dutch still menaced us, and should they obtain control of the Channel, France was prepared to pour a large force into Ireland to assist the rebellion she had been endeavouring to raise there. The danger was, however, averted by the defeat of the Dutch and the complete annihilation of their fleet by Admiral Duncan.

Boer War commenced, 1899.

12th. *Pekin captured, 1860.*—The Chinese refused to observe the treaty of Tientsin, and a party of British officers who had been sent to carry on negotiations was treacherously seized and treated with such horrible cruelty that several of them died. In consequence of this Lord Elgin decided to storm Pekin, and the guns were placed in position, when the city surrendered.

13th. *Execution of Harrison, 1660.*—The first measure undertaken by Parliament after the Restoration was the Act of Indemnity and Oblivion, dealing with all offences committed since the outbreak of the Civil War. Twenty-eight of the king's judges who still survived were tried, and thirteen of them, including Colonel Harrison, were sentenced to death.

14th. *Battle of Hastings, 1066.*—Hastening southward on receipt of the news of William's landing, Harold selected a strong position and intrenched himself on Senlac Hill, near Hastings. His front was protected by a stockade and a rough trench, on his right lay a marsh, while on his left, which was more exposed, Harold placed his trusty *hûs-carls* —the main body of his army consisting merely of half-armed peasants. So skilfully were his forces disposed that the Normans broke again and again against the Saxon defences, and William's cause seemed lost until, by feigning flight, he enticed the ill-disciplined Saxons to leave their position of vantage. Once on open ground, the ill-armed Saxon was helpless against the Norman, and in a short time the field was won.

15th. *The Summer Palace destroyed, 1860.*—When Lord Elgin entered Pekin he determined to impress the Chinese authorities with the danger of treachery and foul play. He therefore completely destroyed the Summer Palace, with all its wonderful collection of artistic treasures and curiosities, and raised on the spot a monument with a Chinese inscription, setting forth that such was the reward of perfidy and cruelty.

16th. *Ridley and Latimer burned at Oxford, 1555.*—"Play the man, Master Ridley," cried the noble Latimer as the flames rose around him; "we shall this day light such a candle, by God's grace, in England as I trust shall never be put out."

17th. *Neville's Cross, 1346.*—On his accession to the throne, Edward the Third renewed the attack on Scotland, and young David Bruce was forced to flee to France, where he obtained arms, money, and men. This action on the part of France was one of the causes that led Edward to invade that country. During his absence David returned to his kingdom, and crossed the border with a formidable army. He was, however, defeated and taken prisoner at Neville's Cross.

18th. *Death of Palmerston, 1865.*—Born 1784; entered Parliament, 1807, as a Tory, but on the death of Canning he became a Whig, and was Foreign Secretary under Grey, and also under Lord Melbourne. He became First Lord of the Treasury in 1855, but resigned three years later. He was again premier from 1859 till his death.

19th. *Cornwallis capitulates, 1781.*—The year 1781 had opened very auspiciously for the English. Cornwallis had routed the American army under Greene at Guilford, and the only hope of success for the insurgents lay in the assistance they received from France, who freely supplied them with ships, troops, and money. In the autumn, however, Cornwallis was completely out-manœuvred by Washington, and allowing himself to be hemmed in at Yorktown, was forced to surrender. This practically brought the war to a close.

20th. *Battle of Navarino, 1827.*—So fearful were the atrocities perpetrated by the Turkish and Egyptian troops under Ibrahim Pasha in crushing the gallant effort made by Greece to secure her independence, that England, Russia, and France agreed to offer mediation, and in the event of either side rejecting the offer, to put an end to the struggle by force. The combined fleet entered Navarino Bay, and as Ibrahim continued his march, slaying and wasting as he went, Admiral Codrington attacked the Egyptian fleet, the whole of which was destroyed or captured.

21st. *Battle of Trafalgar, 1805.*—"Let us be masters of the Channel for six hours," said Napoleon, "and we are masters of the world." In order to effect this, Admiral Villeneuve drew Nelson in pursuit to the West Indies, and then doubled back to crush the Channel Squadron. Nelson, however, discovered the manœuvre, and starting back in hot haste overtook the combined French and Spanish fleets off Cape Trafalgar. "England expects every man to do his duty," ran Nelson's famous signal, and so well was that duty done that twenty of the enemy's vessels struck their flags before the fight was ended; and although the gallant commander lost his life, he had so completely shattered the naval forces of France that never again during the whole of the war did a French fleet venture to put out of harbour.

22nd. *Edict of Nantes revoked, 1685.*—This famous edict, by which Henry the Fourth granted toleration to his Protestant subjects, was revoked by Louis the Fourteenth. Fearful cruelties followed, and although the Protestants were forbidden to cross the borders of France, thousands of them took refuge in flight. Many of these found their way to London, the silk industry of Spitalfields being founded by these refugees.

23rd. *Edgehill, 1642.*—After setting up his standard at Nottingham, Charles received at first a very feeble response to his summons, and had Essex made a sudden dash the struggle might have been ended at a blow. He hesitated, however, and by the time he did attack, the Catholics and gentry had joined the king; and although the result of the skirmish at Edgehill was undecided, the moral advantage rested with the king.

24th. *Peace with China, 1860.*—Although the action of Lord Elgin was considered by many people to be an act of unpardonable vandalism, it appears to have impressed the Chinese authorities, for a treaty was quickly made, China paying both a war indemnity and compensation to the families of the murdered men.

25th. *Battle of Agincourt, 1415.*—Having captured Harfleur, Henry pushed on to Calais; but after crossing the Somme, he found his further progress blocked by a French army numbering about 60,000 men. Although his ranks were terribly thinned by dysentery, Henry had no choice but to attack or starve. While Henry and his men-at-arms flung themselves on the French line, the English archers poured in such deadly flights of arrows that the French were driven from the field. The English army was, however, too exhausted to profit by the victory, but merely continued its march to Calais, and returned to England.

Balaclava, 1854.—The Russians attacked the allies in the hope of obtaining possession of Balaclava, but were repulsed with great loss. During this battle the famous charge was made, when by a fatal mistake 607 men were sent to charge "the Russian army in position." "It is magnificent, but it is not war," said General Bosquet, which, alas, was only too true.

26th. *Doomsday Book completed, 1086.*—For the purpose of ascertaining the "customs" or dues to the Crown, William sent commissioners into each county to ascertain the nature and extent of each estate—the names, number, condition of its inhabitants, its value before and after the Conquest, and the sums due to the Crown.

27th. *Second Battle of Newbury, 1644.*—The success of the Royalists in Scotland and Cornwall emboldened Charles to attempt to march on London; but he found his progress barred at Newbury by a Parliamentary force under Manchester and Cromwell. The attack of the Royalists failed to break the Parliamentary line, but Manchester would not allow Cromwell to attack the king, who was able to withdraw to Oxford. Cromwell saw that unless more energetic measures were taken the war would be prolonged indefinitely; he therefore set about reorganising the army and removing the existing officers.

28th. *Coronation of Henry the Third, 1216.*—As the regalia had been lost when John was overtaken by the tide while crossing the Wash, the coronation ceremony was performed with a bracelet instead of a crown.

29th. *Raleigh executed, 1618.*—After thirteen years' imprisonment, Raleigh was permitted to lead an expedition to Guiana against the Spaniards. The attempt was a failure, and he was executed on the old charge of complicity in the plot to place Arabella Stuart on the throne.

Reform Riots at Bristol, 1831.—The rejection of the Reform Bill was followed by a torrent of indignation. Riots occurred in many parts, particularly at Bristol, where the military were called in and several lives lost.

30th. *Disaster of Nicholson's Neck, 1899.*—In his last effort to prevent himself from being shut up in Ladysmith, General White had the misfortune to lose an entire column, consisting of 29 officers, 898 men, and 4 guns, owing to the mules stampeding and leaving the men without ammunition.

31st. *Surrender of Arcot, 1780.*—Hyder Ali having overrun the Carnatic, defeated the English under Colonel Baillie and captured Arcot.

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

"The time of year.....
When yellow leaves, or none, or few do hang
Upon those boughs which shake against the cold
Bare ruined choirs where late the sweet birds sang."
SHAKESPEARE.

Blue-Book Bits. } THE general reports of H.M. Inspectors are now usefully published separately at the price of 1s. Nevertheless, one never meets with this volume in the schools. I propose to cull a few of the most serviceable items from the 1903 issue.

In some districts "sanitary authorities consider school hygiene the province of the Board of Education, forgetting that 'schools' are included in the definition of a 'house.'"

Infection is often spread by sending scholars to inquire about absentees.

Desks "are mainly too high for children."

Infant Schools Notes. } "The use of the foot-rule may easily, and with advantage, be taught to infants."

"It would be well if desks in a babies' room, and perhaps in other infant rooms, gave way to tables—short tables, twice the width of an ordinary desk, sufficient to seat eight or ten children in small arm-chairs, three or four at each side, one at each end. Three advantages are gained—(*a*) The teacher can move easily amongst her scholars; (*b*) the tables can be placed anywhere in the room; (*c*) the whole, or nearly so, of the floor space can be utilised for games, etc."

"A black dado for chalk-work should run round three sides of the room, with troughs to catch the chalk dust."

"Long ago it was pointed out by H.M. Inspector, Mr. Rooper, that the school is bound to make provision for teaching children to speak; for otherwise, by enforcing order, it deprives them, without compensation, of the chance they would have of learning to speak at home."

English Notes. } "Perhaps the most important consequence of the increased freedom has been the descent to the lower parts of schools of *self-expression in writing*."

"A child does not need to learn by heart the spelling of any word that he does not habitually use. He should, of course, understand when to write 'has' and when 'as,' etc., and should know the spelling of all familiar words. But he should be allowed freely the use of a dictionary when he wants to write such a word as 'symmetrical.' Certainly the boy who, with the dictionary's help, can write a well-spelt letter is better off than the boy who has three times his knowledge of 'spellings,' and cannot use the dictionary."

"The tyranny of neatness is a great impediment to arithmetic."

"It is particularly undesirable to allow children to do composition immediately after having read about the subject on which they are to write."

Reading Notes. } "It may be well to ask whether we do not attach too great a value to the mere *number* of reading books. A shepherd boy, who died in 1775 as librarian of the Imperial Library at Vienna, taught himself to read by means of a printed copy of the Lord's Prayer. Would not a single reading sheet, properly chosen, contain enough to teach the mechanical art of reading?"

"There is much to be said for requiring that at least some reading and text-books be provided by the parents."

How to use the Free Library. } "Mr. Sinclair of Sheffield has devised a scheme for leading boys to become habitual users of the Free Library. The chief features are:—1. Books to be lent in the ordinary way to specially recommended boys. 2. Lessons to be given on different kinds of books (for example, tales, biographies, etc.), on authors, on the care of books, and the use of catalogues. 3. In addition to the ordinary library ticket, the scholar is to have a special ticket; and there is a librarian's form for reporting to the head teacher the ill-treatment of books. 4. Boys who show that they can take proper care of books are to be allowed to continue borrowing after they have left school. Boys must have boys' books, but they must learn that the man who fails to get beyond this sort of mind-food remains a baby as far as his intellectual development is concerned."

THE "NOTEBOOK" QUERY COLUMN.

Letters intended for this column should be addressed "Inspector," care of Editor, PRACTICAL TEACHER. Only in very urgent cases can replies be sent by post, and then only when two stamps accompany the letter.

T.R. writes: "I am engaged in a school in England. Can I obtain marks for teaching, reading, and recitation for the Certificate Examination under the Scotch Education Department?"

Answer.—You can read and recite during the examination week. With reference to the teaching marks, write to the Secretary, Scotch Education Department, Whitehall, London, S.W., and ask whether he will accept your H.M.I.'s assessment.

Anxious wants to know how best to improve her Art. 68 qualification, in view of the possible extermination of this class of teacher.

Answer.—She gives me very little information respecting her previous training and present ability as a student. I think she had better join at once some good correspondence class, and work for two years for the K.S. Examination. In the Code, Anxious will find a list of alternative examinations, one of which she might perhaps consider—the Aberdeen Women's.

M.A.W. is desirous of going to college. She wishes to know when she should apply for permission to sit.

Answer.—The names of all candidates have to be notified to the Board of Education before October 1. M.A.W. should therefore write to the college at once. She is not obliged to sit at the college she aspires to enter. By arrangement she may sit at a centre near her home.

J.C. very kindly writes that my notes have been of help to him. He wants to know whether there is any diploma or certificate obtainable for needlework. He has a lady

assistant who is a clever needlewoman, and anxious to make good use of this talent.

Answer.—There are diplomas granted for dressmaking by the City and Guilds. There is an excellent school for art needlework at South Kensington. I do not know whether certificates are granted by it. Does any reader know of any body that grants certificates? If so, I shall be obliged if he or she will forward the information to me.

T. W. G.—Will you please suggest the easiest subject of drawing other than blackboard required for the Teachers' Certificate Examination, 1904?

Answer.—This is no easy task. It depends more or less on the individual. Assuming that you are not good at drawing, I should choose geometry or perspective. These can be got up more quickly than the others.

L. C. inquires whether a child of thirteen can leave school on attendances without examination.

Answer.—It is impossible to answer this question without reference to the local by-laws. Consult the Clerk of the local School Board or School Attendance Committee.

PHYSICAL TRAINING.

A PROGRESSIVE COURSE FOR ELEMENTARY SCHOOLS.

BY H. RIPPON-SEYMOUR, A.C.,

Chief Instructor, George Watson's College, Edinburgh; Member International Congress of Physical Education, Paris, 1900; Author of "Physical Training," etc.

NOTE.—The military commands given throughout this course are almost exactly in accordance with the commands in the *Infantry Training, 1902*, and the *Model Course*, except where experience has shown a modification desirable. The alternative command will generally be shown in a footnote, and the teacher is at liberty to adopt either.

TENTH LESSON.

Barbell Exercises.

(The words of command are in heavy type.)

Barbell Exercise, No. 4.

102. **"Ready."**—As described before (96).

"First part—One."—Raise the barbell to the front as high as the breast, with the arms straight (Fig. 1).

"Two."—Bend the arms smartly, and bring the hands in towards the shoulders, finger-nails to the front, the barbell close to the breast, without touching it.

"Three."—Push the bell smartly out to the full extent of the arms in the same position as described in "One." Repeat the movements eight (or sixteen) times, when the barbell will be against the breast.

"Second part—One."—Lunge to the right, turning the body in the same direction, and at the same time push the barbell out smartly, as described in "Three" in the first part.

"Two."—Bring back the barbell, as before described ("Two"), remaining on the lunge. Repeat the striking movement eight (or sixteen) times, on the completion of which the barbell will be at the breast, as before.

The body must be kept steady whilst performing these movements, and not allowed to rock backwards and forwards.

"Third part—One."—Reverse the lunge, as before described (57), by turning to the left-about; at the same time strike out as detailed above in "Second part—One."

In this position perform eight (or sixteen) more movements, as before.

"Fourth part—One."—Draw the right foot smartly up to the left; turn to the front, and at the same time push the barbell out in line with the shoulders.

The pupil should now be in the first position. His left foot not having moved from its original place during the whole of the exercise, he will still occupy the same place as at the commencement.

"Two."—Bend the arms as before, and repeat the remainder of the movements until "Seven" (or "Fifteen") is reached.

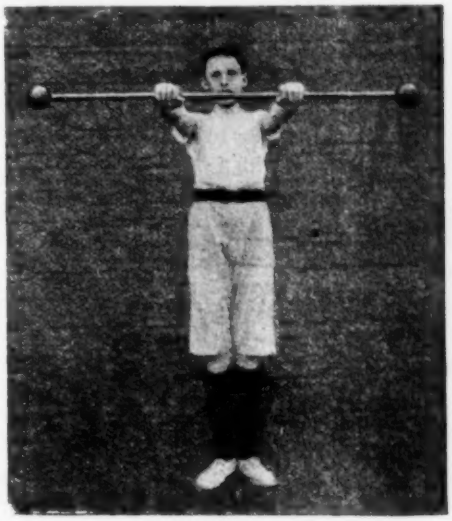


FIG. 1.

"Eight" (or "Sixteen").—Drop the hands quickly down to the sides, and resume the position of "Ready."

Barbell Exercise, No. 5.

103. **"Ready."**—As before described (96).

"One."—Bend the arms at the elbow, and raise the bell to the breast, nearly as high as the shoulders. At the same time carry the right foot ten inches to the right-front, the toe pointed, and the leg quite straight, the toe only being permitted to touch the floor lightly. To maintain the balance during this movement requires some practice, the weight of the body being thrown wholly on the left leg.

"Two."—Push the barbell horizontally to the right as far as the right hand will permit, the left hand resting lightly against the right breast; at the same time carry the

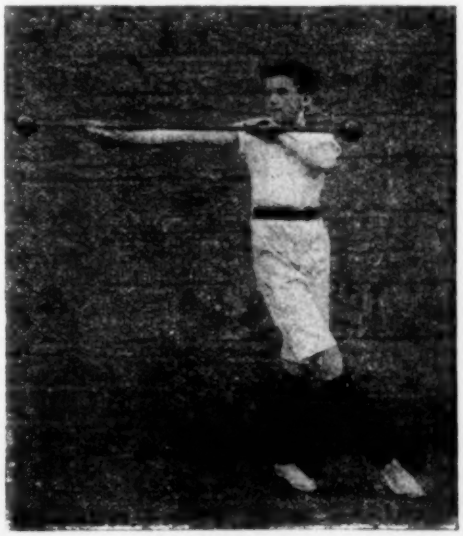


FIG. 2.

toe of the right foot over to a point ten inches to the left-front of the left foot, the leg being straight and toe pointed, as before (Fig. 2).

"**Three.**"—Resume the second position.

"**Four.**"—Bring the barbell smartly down to the "Ready" position, and the right foot back to the left.

FIG. 3.

"**Five,**" "**Six,**" "**Seven,**" and "**Eight.**"—Perform, with the left foot, the movements described for "One," "Two," "Three," and "Four," substituting "Right" for "Left," and *vice versâ*.

This exercise will require much practice, as children find at first great difficulty in combining "opposite" movements, especially where a balance is also necessary. It is an exercise especially suited to girls.

Barbell Exercise, No. 6.

104. "**Ready.**"—As before described.

"**One.**"—Lunge to the right, and at the same time swing the barbell up to the right in a vertical position, raising the right hand, and bringing the left hand just below the right

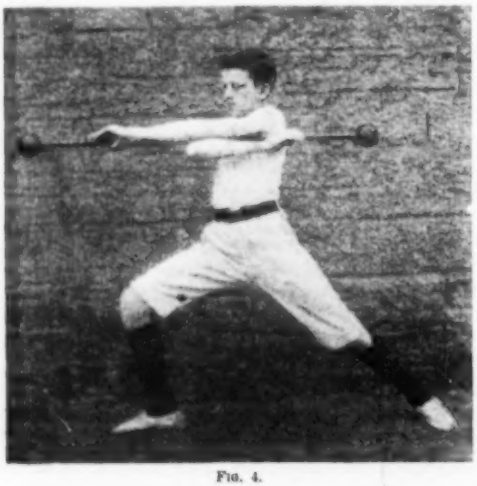


FIG. 4.

breast; the head erect, and eyes directed toward the upper end of barbell (Fig. 3).

"**Two.**"—Twist the barbell over by folding the arms right *under* left, the right hand immediately under the left elbow, the barbell in a horizontal position, the pupil remaining on the lunge (Fig. 4).

"**Three.**"—Twist the barbell back again into its former vertical position, the lunge still being maintained.

"**Four.**"—Recover to the position of "Ready," bringing the right foot back to the left.

"**Five,**" "**Six,**" "**Seven,**" and "**Eight.**"—Perform the same movements to the left side.

The greatest care must be taken in teaching barbell exercises to see that pupils hold their barbells at the correct angles. Properly taught, no exercises are of greater value in training the body, hand, and eye to act together.

The author will be pleased to answer in these columns questions of general interest on drill and physical training. Letters should be addressed to the **Author, care of the Editor,** *and must enclose the coupon on back page of cover.*

NOTES AND JOTTINGS.

WE have received from the Great Eastern Railway Company two little handbooks entitled *Holidays in Northern Germany*, and *Holidays in Denmark and Scandinavia*. Although most of our readers have finished their holidays for this year, yet they are probably so ready for the next ones that they may be making plans already; and if they are in want of picturesque places to visit, a glance at one or other of these little books will decide them. Those who have never tried a continental holiday might well begin with some of the parts described in these little books. We believe they will be sent gratis to intending travellers on application.

THE valuable paper by Dr. Alex. Morgan, of the Church of Scotland Training College, Edinburgh, on the subject of "The Practical Teaching of Geography in Schools and Colleges," which appeared in the *Geographical Teacher* of June 1903, has now been issued by Messrs. G. Philip and Son in the form of a handbook, and we should advise all our readers who did not read the paper in the *Geographical Teacher* to get a copy. It contains some extremely useful directions, and is very fully illustrated.

THE great difficulty students experience in beginning model drawing is that their practice is limited to the exercises they do in class. They may take in a very nice drawing of a jug or teapot, but their teacher cannot tell whether it resembles *the* jug or teapot they copied from. The ordinary sets of geometrical models are too large for the ordinary student to procure for home use, but Mr. Percy Ryde has arranged with a well-known firm of scientific instrument makers for the production of small sets exactly similar to the South Kensington standard models, but smaller in size. These will afford very valuable help for students practising model drawing at home.

A SCHOLARSHIP of the value of £60, tenable for the year 1903–4, at the School of Geography, Oxford, is offered for competition on the 14th of October. Candidates must have taken honours in one of the final schools of the university, and the examination syllabus will be covered by the following books:—Dryer, *Lessons in Physical Geography* (American Book Company); George, *The Relations of Geography and History* (Clarendon Press); Mackinder, *Britain and the British Seas* (Heineman).

THE MOSELEY COMMISSION.—It is difficult to overpraise the motives which prompt a man of wealth to devote a portion of his riches to the thorough investigation of American educational methods by a commission of "experts." It would probably be impertinent and presumptuous to criticise the composition of such a commission, and we content ourselves with an expression of satisfaction that amongst its members is Mr. Harry Coward, President of the N.U.T. His difficulties are certainly not small, whilst his responsibilities are exceedingly great. Those qualities, however, which enabled him to attain the highest honour fifty thousand fellow-teachers can bestow, will be invaluable during his two or three months' stay in the States. In wishing him *bon voyage*, one can safely say that Mr. Coward's report will probably excite as much, if not greater, interest than that of any of his brother-commissioners.

The Practical Infant-School Teacher.

OUR MODEL INFANTS' SCHOOLS.

XVII.

FAR away from a railway centre, where coaches of old-fashioned times are still to be seen toiling noisily along, not far from the highroad, is a small school standing square in a square playground. You come upon it just as you "round a corner," and are astonished at beholding it, for you have passed no village, nor can you see one near, look in what direction you may.

The porch door is open, and the hats and cloaks on the pegs denote that the children are within; the luncheon baskets hanging heavily underneath tell the tale that the children have come for the day. The soft murmur of voices reading collectively assures you that lessons are in progress. You knock, and are admitted. When you tell the mistress that you are a fellow-teacher—in fact, a brother in affliction—she appears to doubt it. Your holiday attire and your snap-shot camera would tell differently; but after a few moments' conversation, in which you let fall various opinions on the new Education Act, the Code, and methods of instruction, she becomes reconciled to the fact that even if you are not a real teacher, at least you know something of a school.

You express surprise that, although the school does not look particularly new, some of the furniture and apparatus, and for certain the clock, does. She tells you that this is the outward and visible sign that a newly-formed Education Committee for the county has set to work. In former days, to need a clock was quite an absurdity. What was the watch on the mistress's wrist for but to save the school managers a sovereign or so on a clock? The children were accustomed to walk a good distance to school; why could they not stand at their lessons—at least most of them—and save the purchase of desks? Besides, would they not in a few years' time have to stand hedging and hoeing, and such-like? Why not stand now while they are young, and get used to it?

Ah! why indeed? Things are altered, and there is a pretty good display of furniture and apparatus. The room looks quite bonny.

The children notice that the mistress is talking to a stranger, and all the classes have stopped their work. They stare and nudge each other, and now and then indulge in a tiny, subdued titter, not offensive but playful. Even the class there in the corner, in charge of a monitor, has ceased to work, and is taking stock of him who is carrying the funny bag with a kind of a window in front—the lens.

Teaching Subtraction.

But now all re-commence. The mistress goes on with her lesson, the two small classes next hers write their copy, and the class in the corner under the monitor gets once again to work. The mistress's lesson is a very interesting one. She is teaching subtraction, and in doing so is using a number of wooden balls somewhat of the size of small oranges. The number being dealt with is eight, and the exercises given and demonstrated are—*one*, *two*, *three*, etc., from eight. This is evidently not the first lesson of its kind, for the children are perfectly at home in handling the wooden balls. These are used to illustrate the exercises. When a question is set—for example, three away from eight—a child comes to the front of the class, and from the eight balls takes away the three, and counts the remainder. He then calls out so as to be heard by all, "Three balls away from eight balls leaves five balls." The mistress asks what he would say if they were apples, and the boy answers, "Three apples away from eight apples leaves five apples," and so on, using other names of things. At last the abstract form is reached, "Three from eight five," and the exercise is at this early stage written on the blackboard in the following form: 8 – 3 = 5. This method gives the children a large number of recapitulatory exercises dealing with the same numbers, and this constant repetition is a help to the memory and an aid to those who are less bright at their tasks than the others. Later on in the school year the

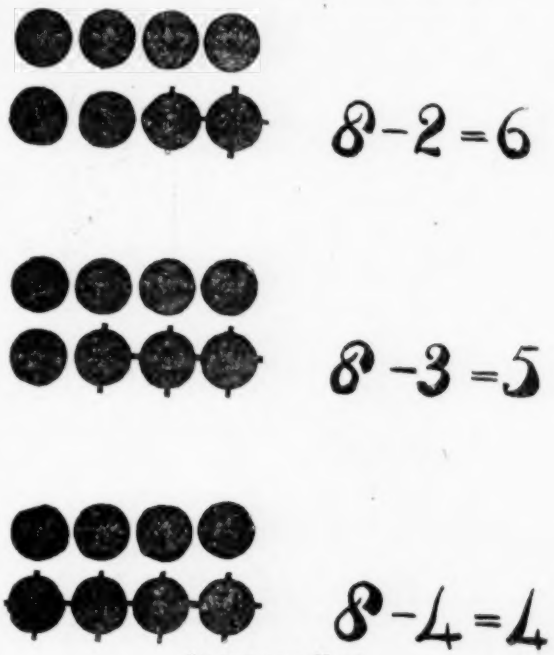


Illustration No. 1.

higher numbers are illustrated in the same way, and the other rules taught by means of the same wooden balls. Further than this, a good way of revising and fixing the lesson was shown. When all the numbers from one to seven away from eight had been dealt with, it was time to look at the handwriting of the children near, and the mistress asked the class to show the visitor how nicely they could make some sums of their own on the pattern of the lesson. Small pieces of paper were handed round, and it was amusing to see how quickly the children set to work. Each child took from beneath the desk a piece of lead pencil

which was tied to the desk by means of a piece of string. The string was of such a length as to permit of the correct use of the pencil. This seemed to be a very convenient way of keeping the pencils handy, and seldom is one detached from the string and lost. (No Sunday school is held in the building.) The exercises were done in varying forms: one of them, which will show the general character, and the nearest to the pattern on the blackboard, is given in illustration No. 1. What was done clearly showed that the idea of "taking away" had been fairly grasped. The children did not know *minus* or *equals*, but used the words as mentioned above. The next stage of the work will introduce the usual way of setting down a subtraction sum with the lesser number written beneath the greater.

The handwriting was very good indeed, especially when it is taken into consideration that on this particular occasion there had been no oversight to the lesson. As a rule there is, for the mistress leaves her own class at an opportune moment to superintend and give an occasional hint. So does the monitor in turn leave hers for the same purpose. But visitors are scarce—the attendance officer, indeed, has only been once since Easter, and it is now the middle of July—and when one *is* about, that which lies between the things in hand must go and take its chance, each teacher hoping for the best.

It is pleasant to note the quietness of country children. The schoolroom atmosphere has evidently a very soothing influence on them, and they seem almost awed—very different indeed from more alert children of the city. They take pride and interest in their work too, and seem to be intent on their task. Of course this kind of thing is a credit to the mistress, for there is no doubt that it would not exist, at least to a very great extent, without her influence.

To a city teacher the reading appeared to be rather drawly and monotonous. The voice was pitched rather high, somewhere about G at a guess, but it was clear and distinct. The teaching of the monitor was fairly good. She over-corrected, however, and her constant interruptions in the sentences as the children read them were irritating. Mistakes will be made in the best classes, but a better way of correction—which indeed the monitor agreed to when the point was put to her—is to let the child read on till the end of the sentence is reached, then check and correct; or let the children who listen detect the mistakes, and indicate by raising the hand that they notice them. This, however, tends to bad order if the reading class is standing, for there is the holding of the books to take into consideration. The pattern reading, which is so essential in the teaching of children of all ages, was very good, and frequently exercised.

Object Teaching.

In addition to the general routine, there is a good scheme of object teaching and a very extensive and varied form of "occupation." The teaching of general information, by means of object lessons, is confined to such things as can conveniently be obtained. Nature study is touched by dealing with flowers and specimens of plants which the neighbourhood affords, and the children are encouraged to bring what they gather. The mistress is well informed on such plants, and the children have, through her sympathetic lessons, grown very keen on watching their habits. The phenomenon of the action of frost on rocks is well illustrated in the district, and is taken advantage of in the teaching. The sea-coast, which is not very far away, is lined by—in fact littered with—a large number of boulders of various sizes. These have been broken off from the cliffs by the wear and tear of frost, and wind, and rain, and rounded by means of wave-washings and tide movements. The children wander along the beach, and experience afresh the teaching in the schoolroom. Sand further illustrates the point, and shells of various sizes and shapes are studied. There is a good collection of dog-fishes' eggs stitched on a card in one of the window ledges, and a talk has taken place on them. The children know the use of tendrils, and also that where they are missing something has broken them off. Sea-weeds of many hues and forms are gathered, and although not worried by their names, the children arrange them on cards and dry them according to their form and growth. The crab, the prawn, the star-fish, and the jelly-fish form the subjects of other lessons, and so much local information is taught. The saltness of sea water is tested and compared with the purity of the water that is drawn for drinking purposes from the roadside well. The crops in the fields are discussed, and their times of planting

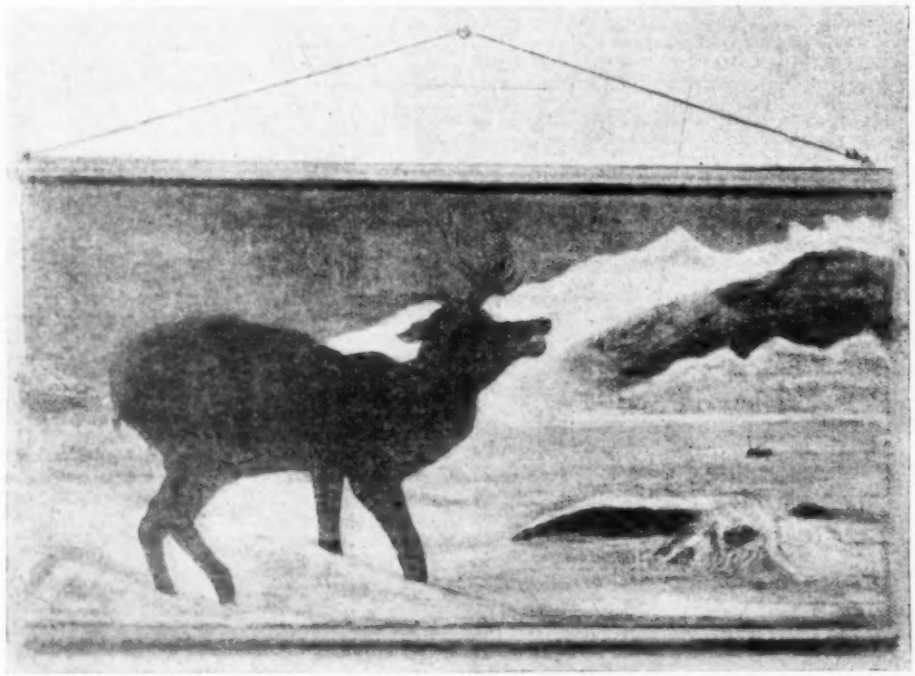


Illustration No. 2.

and gathering are recorded. These local lessons, if such they may be called, although intensely interesting, would be as monotonous as the reading if they were the only ones. But the mistress is wide enough awake to see this, and she wisely supplements them by lessons on animals—domestic and otherwise—and various manufactured articles. The paraffin lamp is an example of this latter, and the occasion is enriched by a talk on the dangerous nature of paraffin vapour. The way in which town children are provided with water, as compared with the way these obtain theirs, forms another lesson. A picture drawn by the mistress on common brown paper hangs under the clock, and illustrates a lesson on a Highland scene. (See Illustration No. 2.) The children like lessons of this nature, and think very highly of the ability of the mistress in drawing her own pictures.

There are only two divisions for object teaching—ages three and four, and five and six; and to secure good teaching in them the mistress prefers to take them herself, leaving the monitor at the time to superintend some quiet work. She considers this pays.

Varied Occupations.

The mention of home-made pictures leads to another subject. The children do not learn drawing, except to a very small extent in the top class, where the pencils are attached to the desk; but very interesting work is provided for them by the mistress drawing sketches of leaves, and fruits, and various easy objects, such as an egg, a garden spade, a rake, an elevation of a wheelbarrow, and a bell on coloured paper. (Paper of this kind, and gummed at the back, may be purchased from Messrs. E. J. Arnold and Son of Leeds, at from 3d. to 5d. a packet.) When they have been drawn the children cut them out with their own scissors, and the mistress pastes the best on millboard or thick paper, and uses them for decorative purposes. Several of these sheets are conspicuous along one side of the schoolroom. Illustration No. 3 shows what one of them looks like. The colour of the cut paper in this case is bright red, and the mount is white cardboard grown brownish by age. Further practice is provided by the children themselves bringing paper of any sort—brown or blue sugar paper serves the purpose admirably—and cutting forms without previous drawings as well as they can. On some occasions good specimens are made in this way. On long winter evenings the older children from the boys' school draw leaves, etc., at home for the little ones to cut, and sometimes the mothers and fathers make the "occupation" a winter "amusement." Occasionally suitable drawings are sent down from the boys' school for the infants to cut.

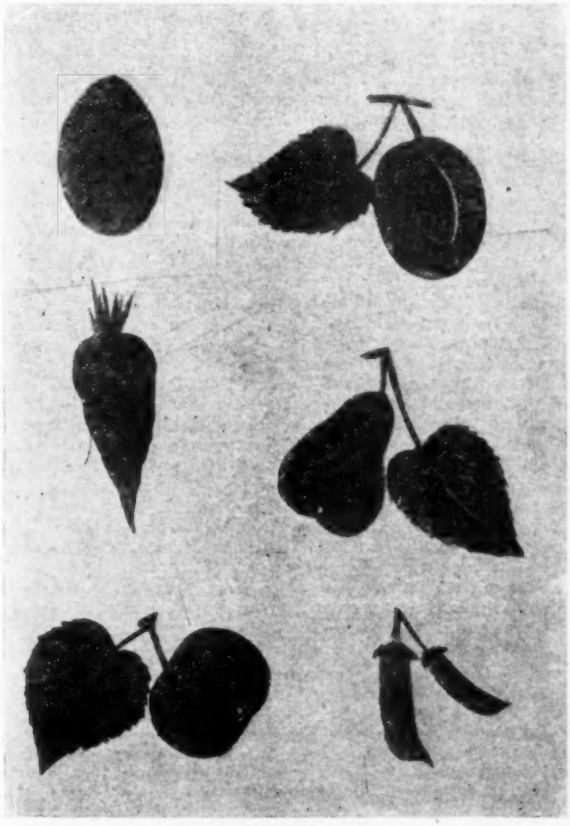


Illustration No 3.

Bead-threading is popular, and some very pretty hanging specimens are displayed in the school. These, it must be said, have been purchased by the mistress, as the managers of the school expect the beads they have provided to last till doomsday. The mistress thoroughly believes in "occupation," and in the hope that under a new and more progressive system of management she may be able to make a development in this direction, she has requisitioned a large supply of scraps and books. With these she intends that the older children shall make playbooks for the younger. She has already several scrap picture books in use, and she finds them very acceptable employment on Friday afternoons.

Recitation.

The children sing very nicely in one division, and repeat a large number of verses. In this latter subject the mistress is not content with teaching one poem. Several pieces are learned each year, some of them being very short indeed. She finds a difficulty in lighting on suitable pieces; but as she is herself inclined to be poetic, she makes what she wants. How inventive and resourceful an infants' mistress has to be! One of her customs is—and a very pretty custom it is, too, when it can be done fairly well—that when she gives a book as a reward to a scholar, she writes under the child's name a line or two of poetry suitable to the child or the occasion, and is glad if the child will learn it by heart. An example of this was instanced during the visit. On the previous Friday a boy named Joseph Mills had brought a nice young rabbit for the mistress, which his father had caught, and which he thought would make a nice little pie for the "governess." The governess accepted the gift, as she knew it was sent with the best of intentions; and not to be in the father's debt she gave Joseph a little book. Under the name she wrote:—

"If you will read,
My Master Mills,
You'll sow good seed—
You will indeed;
The seed will grow,
And you will know
That all aglow,
Quite free from ills
You'll be, my Master Mills."

These lines had in the course of a few days been taught to the little fellow by some one at home; and the pleasure he experienced when asked to come into the front of the children and say them was very great. The benefit to the child and the influence on the school generally cannot be measured.

It need hardly be said that the mistress is thoroughly happy in her work. She feels lonesome sometimes, as the company she gets is, with the exception of one or two lady friends, below her own station and education. She makes the best of it, and spends a great deal of time in making preparation for school and evolving new schemes. In summer she devotes her leisure to walking, cycling, and quiet reading. For the institution of the N.U.T. lending library she is very grateful.

ROYAL READING SHEETS.
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READING IN THE BABIES' CLASS.

OF all the difficulties that confront an infants' teacher, and a babies' teacher especially, perhaps none are so great as those connected with the teaching of reading. "As easy as A B C," although an expression often used, is a misnomer, for in actual experience the learning of the alphabet is monotonous and wearisome in the extreme. Happily, the days when the A for apple, B for baby style of teaching prevailed are gone, and gone for ever, let us hope.

So much by way of introduction. What we are here specially concerned with is the teaching of reading in the babies' room. *Reading*, be it observed; not letters, or even sounds *at first*. It is now pretty generally acknowledged that the learning of letters is practically useless as far as teaching reading goes. Since the repetition of the names of the letters gives no clue to the word, this can only be obtained by setting up an arbitrary or artificial connection, and so the alphabetic method has come to be looked upon as unnatural and unintelligent. We have certainly moved a step in advance when we substitute sounds for names of letters; but even here we have not done away with all the disadvantages of the alphabetic method, for in both cases the early stages are monotonous, tedious, and quite meaningless to a child, since he is unable at this stage to associate what he is trying to learn with anything in his experience.

Children do not learn to speak by using letters or sounds, but words themselves, beginning with names of things familiar to them. Then why should they not be taught reading in the same way? Similarly, in the learning of grammar the parts of speech are best learned by the work they do in a sentence—through analysis; and analytical modes of teaching are invariably easier than synthetical, certainly they are more interesting. Hence the reason for advocating the teaching of reading by words themselves instead of by their elements. Let any who are inclined to be sceptical try this method before passing judgment. The writer can speak from several years' experience as to its efficacy. There are now several good conversational reading sheets and books published, Blackie and Son having been among the first to produce the former.

As an introductory series of lessons, it is well to begin by leading the children to distinguish clearly between an object, a picture, and the name or symbol, and here the blackboard will be found of the greatest service. Perhaps it will be as well to say at the outset that none of the examples given should exceed *three* letters, and should be such as children are familiar with—for example, box, fly, cat. Perhaps a *box* is the simplest of all to begin with, for it is easy to demonstrate to the class the difference between a real box and a picture, the picture to be drawn by the teacher on the blackboard, preferably with coloured chalk, then the word printed at the side thus:—

box

The children are then told that it is the name of the object—the name or word "box"—and so on with each of the others. After a few such lessons they become familiar with the signs, so that the word alone calls up the idea; and before passing on to the reading sheets, it is well to test how far the lessons have been impressed by printing the word *alone* without the picture on the blackboard. This, of course, is a mere outline of the method of introduction, as variety in detail will naturally occur to most teachers.

It will now be time to begin with the first reading sheet. This will afford scope for training speech as well as the powers of observation and quickening the general intelligence. As before, each word is taught by means of a picture illustrating it. If Blackie's "Conversational Sheets" are used, we have on Sheet I. the three words—

cat rat fat

with a picture of a cat and a rat, and full instructions as to the manner of teaching. Suffice it to say here that in every case the *first step* is a conversation to introduce the word; and, *second step*, the word is impressed by having identical ones pointed out by the children themselves that are not directly connected with the picture. In the case of very young children these two steps will need constant repetition, but here we see the advantage over all other methods. Although for several lessons we have to confine ourselves to the same words, these may be dealt with in different ways in each lesson. For instance, the lesson one day may take the form of a story about a "cat and a rat," in the course of which the words cat, rat, and fat are introduced, and as they are referred to can be pointed out on the sheet by individual children, and printed on the blackboard by the teacher. Many other expedients for keeping up the interest will at once occur to a wide-awake teacher; in fact, in many of the lessons the children should not know they are having a reading lesson at all until they have made some little progress. Of course, as time goes on less attention should be given to the conversational part and more to word-saying.

When the words are sufficiently well known, we come to simple sentences containing them; for example:—

it is a cat
it is a rat
it is a fat cat

but these are best taught by using the blackboard. By referring to the picture, the sentence "it is a cat" may be obtained from the class; and this should be printed on the blackboard, special attention being given to the new words "it" and "is," and similar ones may be pointed out on the sheet. The other sentences are to be dealt with in the same way.

So far we are employing the "look and say" method. When, however, the children have become sufficiently familiar with words, these may be analysed into their sounds, and in this way the powers of the letters will be more readily understood when their work is known than if they were learned singly. Thus the children know what they are doing at the outset, and the lessons afford scope for infinite variety in the hands of a resourceful teacher.

At this stage also, if desired, word-building may be commenced, the syllable "at" being taken as the root, analysed into its sounds, and then the sounds of the initial letters c, r, f, m, p, etc., taught as these are added. This introduces another variation, and if different coloured chalks are used for the different initial letters, the distinction will be brought out more clearly. At this stage the advantages of this method will be obvious, for instead of the monotonous spelling g-o go, i-n in, formerly in vogue for the purpose of fixing the words and instilling a love (or hatred) of reading in the mind of the child, we here have at our command conversational lessons, word-saying, word-analysing (into sounds), and word-building, all or any of which can be resorted to in order to impress the same words or sets of words, so that no two lessons in the week need be absolutely alike. The word-building lessons should, of course, always correspond with the reading sheet that is being taken at the time.

Obviously the names of the letters cannot be taught in the reading lesson, at least in the babies' class, as the attempt would only lead to confusion; besides, as we have seen, these are not only unnecessary but quite useless for teaching reading, unless an artificial connection be set up through spelling. Still, it is of course advisable that the names of the letters should be taught, and that the children should know them before they leave the infants' school, but this can easily be managed if they are taught incidentally through the kindergarten occupations. Stick-laying may be made use of for teaching the capital letters with straight lines, while those with curves may be made in a twist or thread-laying lesson. The names should also, of course, be taught in the writing lesson, since it is principally for writing purposes that they require to be known.

Those who desire to break away from the dead level of monotony, which has so long accompanied the teaching of reading in the early stages, are advised to try this method. The results will be surprising.

EXPERTO CREDE.

SOME GOOD ADVICE AS TO HOLIDAY COURSES.

BY A. E. STYLER.

AFTER a month's hard work at holiday courses, the English student sometimes returns home with a dismal feeling of disappointment and despondency. His progress does not compare well with the effort expended; yet his partial failure is probably only the natural consequence of imperfect preparation at home and wrong methods of work abroad.

Preparation.—I am writing for the benefit of that numerous type of student who knows more or less of the written language, and who attends holiday courses in order to increase his practical skill in using and understanding the spoken language. I shall therefore, at the risk of being tiresome, begin with my oft-repeated advice to prepare thoroughly at home. If the student would resolve to commence studying for his journey a whole year beforehand, and work upon a systematic plan of reading aloud as much as possible, and with as little translation as possible, he would accomplish much more in the month than is usually the case. The very backward student should take lessons in pronunciation, in order to avoid making gross errors habitually. He should then set to work upon French books with the English translation, not forgetting to use a good dictionary to clear up doubtful points. This method is often condemned, but for an intelligent adult learner it is a valuable means of saving time. As to grammar, it is advisable to learn the verbs as speedily as possible, picking up the rest by reference to a good grammar as the reading proceeds. "Languages are learned by reading and talking," not by grammar.

Now to take the case of a more advanced student who can read French fairly well. He should choose the kind of literature which *interests* him most, for he will find that learning a language is a long affair. He is like the traveller upon a long and tiresome journey, who needs the fascination of beautiful scenery, or some other engrossing interest, to beguile the tedium of the way. The real lover of literature is enticed onwards from volume to volume, and often learns a difficult language without much conscious effort and with ever-increasing pleasure.

Another important point is to make use of a good, copious dictionary, written entirely in the language under study. Take the following passage from Flaubert's great novel, *Madame Bovary:* "De grands plats de crême jaune.....présentaient, dessinés sur leur surface unie, les chiffres des nouveaux époux en arabesques de *nonpareille*." Now, as an item of practical knowledge, it does not matter a button what *nonpareille* may be, and it would be waste of time to look it up in a French-English dictionary. But if the student reads up such words in a dictionary which is entirely French, he does not waste his time, for he is using the foreign language as an instrument of thought all the time. Moreover, he acquires in this way the valuable habit of reading thoroughly, without which the best of the author's meaning is often lost.

Perhaps the most useful advice of all is, Avoid the *habit* of translation. The unfortunate student who is preparing for an examination must translate a great deal; but he is none the less acquiring a mental trick which will prove a great obstacle to his progress. Even the advanced student has a feeling of confusion when the conversation necessitates constant translation; for example, when a French friend questions him about prices which he only knows in English money, or distances which he has always thought of in English miles, or the gear of his bicycle, which he gauges as a diameter in inches—quite a different thing from the French cyclist's *développement*. In short, he must learn the knack of thinking French thoughts, or remain unintelligible to the Frenchman by talking English thinly disguised in French words.

Choice of a Course.—We will now imagine the student arrived in the French town, and about to choose his professor. He will do well to be modest, and select a course which is too easy for him rather than one which is too difficult. If he feels the need of something really arduous, he can always find it when talking with uneducated or half-educated people. It is foolish to waste one's time in attending a lecture which is so far beyond the listener's powers that the thread is lost and only a word caught here and there. The only result is a bad headache.

Students are apt to despair when they land in France and find themselves utterly unable to make sense of a Frenchman's torrent of words. And yet there may be no need for despair. At home in England we do not really *hear* the half of what is said to us; but the phrases are so familiar that one word—nay, one syllable—is often enough to enable us to seize the meaning. Ignorance of French phrases is one great cause of the apparent dullness of ear, and the well-read student will soon overcome this kind of slowness.

La Flânerie.—At all holiday courses which I have visited excursions are organised. I have noticed that in Normandy English students speak their own language far too much on these occasions. At Geneva, Russians, Germans, Servians, Swedes, all kept well to the French. At Jena, students remained pretty faithful to the German, the good habit being facilitated by the fact that the Germans themselves were in a majority.

But better than any excursion planned for a large flock of students is the habit of rambling alone, or with a single companion, speaking with all kinds of people. This is especially useful for the more advanced students, because of the added difficulty of understanding those who have a touch of dialect. Pluck and initiative are required for this method, but French politeness and good nature are a great help. The Englishman who is evidently in earnest in studying French life and language always meets with respect and consideration, particularly if he is broad-minded and tolerant. He will find some persons almost unintelligible, others quite clear and distinct, and as he progresses he will end by understanding them all. A certain amount of tact is requisite; but when once the habit is acquired the learner is on the right track, and will probably make a good linguist.

I remember once, during a stay of only a few days at Dieppe, having long and often interesting conversations under the most varied circumstances. Immediately upon landing I had an animated discussion with the *douaniers* as to the payment of thirty francs for my bicycle "consignation en garantie de réexportation." Then each day there were frequent opportunities for pleasant chats with the French family with whom I lodged, or with the people of the pretty villages for miles round. One day I had a long conversation on the sea-front with a French visitor—a conversation which began quite naturally apropos of a word in the newspaper we were reading side by side. The proprietor of a café I frequented was a quaint old veteran, who had been through the horrors of the *année terrible*, and was now a member of the "Ligue de la Paix." He used to tell me tales of war

and bloodshed, and of the exploits of his comrades. Other *habitués* of the same establishment often engaged me in chatter lasting the whole evening, and this I found somewhat fatiguing; for a Frenchman thoroughly wound up will not stop for any music, however loud. On another occasion I bicycled over to Tréport, the pretty little seaport nestling between the tall white cliffs, and had a keen discussion with a young French cyclist on the beach as to the comparative merits of his *bicyclette à pétrole* and my *roue libre*. In other directions I made the acquaintance of a rural *instituteur*, and asked him to give me an account of his method of imparting "anti-alcoholic" instruction, ending my day's ramble by chatting with the *gardien* of the lighthouse at Ailly about lights and lightships, and with the lonely shepherd of the Forêt d'Arques on the sheep-rearing industry of Australia.

LE TRAVAIL DU STYLE, ENSEIGNÉ PAR LES CORRECTIONS MANUSCRITES DES GRANDS ÉCRIVAINS. Par M. Antoine Albalat.

A REVIEW of this work finds a fitting place in our Modern Language Section, in which we endeavour to cater not only for the student who is painfully labouring upwards towards a fair working knowledge of a modern language, but also for the one who, having mounted higher, is able to breathe awhile, and to take a wider and more comprehensive view. To students of French literature M. Albalat needs no introduction. In his *Art d'Ecrire*, and in his work on the formation of style, he has shown us how it is possible to discover the principles which underlie the formation of style, and the art of applying those principles.

The work under review is complementary to the two mentioned above. So far as we know, it has not before occurred to a literary man to stand as it were at the elbow of a great writer and to note the successive corrections he applies to his work in order to make it satisfy his own fastidious taste. It has been claimed for some great masters of literary style that they never blotted a word; but these are the exceptions.

M. Albalat justifies his work on the ground that the study of manuscripts is the best course of literature that could be followed, as we have at one and the same time precept and example.

Châteaubriand, himself a great master of style, long ago expressed the opinion that much could be learned by a study of the manuscripts of the great writers. We quote his words:—

"Je conseillerais l'étude des manuscrits originaux des auteurs du grand siècle. Racine, Boileau, Bossuet et Fénelon nous apprendront à corriger, à limer, à arrondir leurs phrases, et puisque nous ne pouvons égaler leur génie, leurs nombreuses râtures même nous enseigneront quelque chose de l'art dont ils l'ont revêtu."

Fortified by this opinion, M. Albalat has made extensive researches into the manuscripts of the great French authors to which he could get access, and while quoting the numerous revisions and re-revisions to which many passages have been subjected before publication, he endeavours to show the reasons which have decided the alterations. It is precisely those authors who have most patiently, by frequent alterations and recastings, endeavoured to arrive at absolute perfection of literary expression who are now acknowledged as masters of French style. From the example of the pains they took, M. Albalat comes to the conclusion that patient and laborious effort are necessary to produce literary excellence.

But correction does not necessarily imply improvement. The general effect of the corrections of Châteaubriand, Flaubert, Bossuet, Pascal, and many other authors cited by M. Albalat, is to produce more perfect work. On the other hand, Fénelon is taken as an example of a writer who corrected abundantly, but without improving his style. Forming yet another class are authors like Stendhal, Georges Sand, and Dumas père, whose literary style suffers from want of labour being bestowed upon it.

M. Albalat complains that one of his difficulties in writing *Le Travail du Style* consisted in the abundance of the material he had to select from. That is also one of the difficulties of his reviewer, who has to select for a short article from the number of well-chosen examples with which the author illustrates his theories. Before citing any of these examples, we should like to quote M. Albalat's own defence of the position he takes up, that correction is not a mark of weakness but a sign of strength in an author:—

"La refonte n'est pas une signe d'impuissance, c'est, au contraire, une preuve du talent. Tout le monde n'est pas capable d'apercevoir ce qu'il faut retoucher et comment il faut retoucher. C'est être déjà écrivain que de reconnâitre qu'on peut mieux écrire. Seul un esprit supérieur devine ce qui lui manque."

Answering another common objection, our author arrives again at the conclusion that correction is a sign of strength, not of weakness:—

"On prétend que le style naturel ne se cherche pas, et que le style travaillé sent toujours l'effort. Ce qu'on peut dire, c'est qu'il est difficile, en effet, de dissimuler le labeur, et qu'il se trahit presque toujours. Mais ce défaut n'est pas une infériorité. De grands artistes comme Boileau, La Bruyère, Montesquieu, Rousseau, ont mérité ce reproche, et ne s'en sont pas mal trouvés. Il n'est pas du tout désagréable de constater chez un auteur la science d'écrire. Qu'importe qu'une belle image ait été cherchée s'il faut être bon écrivain pour l'avoir trouvée?"

The space at our command does not, unfortunately, allow us to quote the longer cases of well-judged revision contained in M. Albalat's book.

Improvement by condensation is well illustrated by the following example from Châteaubriand, who changes "*Pour se plaire* aux souvenirs, *il faut avoir* des espérances," into "*Qui se plaît* aux souvenirs, *conserve* des espérances."

The following corrections show how rigorously Châteaubriand tried to avoid disagreeable assonances. "Je me sentais extrêmement *contraint;* la *crainte* de dépasser certain niveau m'ôtait jusqu'à cette faculté des choses communes," becomes "Je me sentais extrêmement *contraint;* la *peur* de dépasser certain niveau m'ôtait jusqu'à cette faculté des choses communes." Again, "Jehan *voulut voler* au secours de son fils Charles," is altered into "Jehan *voulut aller* au secours de son fils Charles;" whilst "*détaché* d'un *attachement*," becomes "détaché d'un amour."

Still taking Châteaubriand's corrections as examples worthy of imitation, M. Albalat quotes a very good example of condensation which brings the dominant idea into bolder relief: "*Une heure après la mort* des plus grands hommes que *reste-t-il d'eux?* Un manteau gris et une croix de paille." This is altered into "Que reste-t-il de la mort des plus grands hommes? Un manteau gris et une croix de paille."

The effect of the metaphor is not always weakened by the alteration of vigorous into more chastened expressions.

"Le *fracas* d'un siècle s'affaiblit par degrés et s'éteint dans le silence éternel, à mesure que le *bruit* d'un autre siècle commence." The image gains immeasurably in beauty and unity by the simple alteration of the italicised words:—

"Le *souffle* d'un siècle s'affaiblit par degrés et s'éteint dans le silence éternel, à mesure que la *respiration* d'un autre siècle commence."

Flaubert affords another example of a great writer who believed with Joseph de Maistre that "Rien de ce qui se fait bien ne se fait vite." Thus we find him writing but fifteen pages in seven weeks, and again twenty pages in two months. He would have been a failure as a newspaper man. He hated stereotyped expressions, rigorously avoided assonances, and continually strove to render his style harmonious. By pushing condensation to its utmost limits he heightens the effects he wishes to produce. Thus: "Quand l'ennui d'Emma *quelque temps se fut arrêté sur cette déception, et que les souvenirs du passé comme une danse eurent bien tourné tout autour de sa tête*, la place de nouveau resta vide et alors la série des mêmes journées recommença," becomes, on revision, "Après l'ennui de cette déception, son cœur de nouveau resta vide, et alors la série des mêmes journées recommença."

Again, "Dès lors le souvenir de Léon fut le centre de ses ennuis, *l'occupation de son désœuvrement, la compagnie même de sa solitude*, et il y pétillait comme dans un steppe de Russie un feu que *des voyageurs disparus ont laissé* sur la neige," is abbreviated into, "Dès lors ce souvenir de Léon fut comme le centre de son ennui ; il y pétillait plus fort que dans un steppe de Russie un feu de voyageurs abandonné sur la neige."

Flaubert made only a sparing use of auxiliary verbs, and of verbs like *faire* and *mettre*, which can be used in many different acceptations.

So "Son grand œil bleu levé vers les nuages *parut être* à Emma plus limpide et plus beau que ces lacs de montagne où le ciel se mire" becomes "Son grand œil bleu levé vers les nuages *parut* à Emma plus limpide et plus beau que ces lacs de montagne où le ciel se mire."

For "Les torches *faisaient* des taches rouges," and "Il *faisait* semblant de se vouloir cacher," he substitutes "Les torches *jetaient* des taches rouges," and "Il *feignait* de se vouloir cacher."

Space does not permit us to follow M. Albalat in the examples he gives of effective corrections from other authors, but we cannot forbear quoting a magnificent example of splendid condensation. Pascal wrote: "Est-ce courage à un homme mourant d'aller, dans la faiblesse et dans l'agonie, affronter un Dieu tout puissant et éternel?" In the revision it becomes, "Rien n'est plus lâche que de faire le brave contre Dieu."

M. Albalat urges against Fénelon as a writer that he had no conception of what a descriptive style really meant, that he aimed rather at avoiding defects than at displaying beauties of style, and that, as a consequence of this timidity, his style, although displaying a great amount of florid elegance, was weak. The numerous quotations he makes certainly support these contentions of M. Albalat, and the many instances cited of unhappy alterations tend to prove that Fénelon lacked a true appreciation of good literary style.

As a contrast to the examples of effective alteration which he quotes, M. Albalat gives instances from Massillon and other writers which show the bad results of a lack of correction. The whole work is worthy of the closest study; those students especially who are intending to make a close study of French literature should read it carefully. It will inform and elevate their taste, and will to some extent help to direct their reading.

VOULEZ-VOUS savoir pourquoi l'habitude de donner des étrennes n'est pas près de finir? Eh bien! écoutez ceci: Est-ce que ça ne t'ennuie pas de donner des étrennes! Oh si! mais ça embête tant les autres!

SCHLECHTE BERUHIGUNG. — Vater: "Ich hätte nicht geglaubt dass das Studieren so viel Geld kosten würde!" Sohn: "Ja, und dabei studiere ich noch nicht einmal viel."

PROFESSOR: "Was wissen Sie mir über Plato zu sagen?"
Examinand: "Gott sei Dank!—nur Gutes!"

MUSIKER: "Nun, Herr Doktor, was sagen Sie zu meinen Kompositionen?"
Kritiker: "Was ich dazu sage? Nun, man wird sie spielen, wenn Beethoven, Schubert und Wagner vergessen sind."
Musiker: "Wirklich?"
Kritiker: "Ja, aber nicht eher."

WAS Hänschen nicht lernt, lernt Hans nimmermehr.

GOURVILLE, rencontrant au Bois de Boulogne un médecin de ses amis armé d'un fusil, lui dit: "Où allez-vous donc?" "Voir un malade à Auteuil." "Il paraît," répliqua Gourville "que vous avez peur de le manquer."

MODERN LANGUAGE TEACHING IN THE SECONDARY SCHOOLS OF SCOTLAND.

THE Blue-Book containing the report of the Scotch Education Department on the secondary schools under its control has just been published, and affords very interesting reading. The number of secondary schools or departments coming under Government inspection is ninety-four, attended by over 24,000 scholars. It is possible, therefore, from so large a proportion of the total number of scholars in Scotch secondary schools to form just conclusions as to the general state of secondary education across the Border; and the absolutely independent position of the examiners, with regard to the schools they visit, does not expose them to the temptation of passing lightly over such defects as call for remark. Outspokenness and suggestiveness are the leading features of the document before us. Deficiencies are freely criticised, and improvements noted wherever they occur.

We propose only to deal with the part of the report which refers to modern language teaching. Before touching upon the actual criticisms on the results of this teaching, we quote an important passage from the general report:—

"They (that is, the inspectors) have again been asked to direct special attention to the pronunciation of modern languages—an aspect of the teaching that only admits of being adequately tested orally. Two or three years ago local managers were informed that schools in which the report of the inspector showed that this part had been neglected were liable to be excluded from the Leaving Certificate Examination. Your Lordships last year took the further step of making the issue of Leaving and Intermediate Certificates to individual pupils in every school dependent upon a satisfactory report being given by the inspector as to the appearance made by each candidate under oral examination. That measure promises to have a very salutary effect."

We should like to continue the quotation, which proceeds to deal with the more scientific study of languages; but we have introduced it for the purpose of showing how enormously a body like the Scotch Education Department can advance the better teaching of modern languages when it makes such a regulation as the one quoted. We hope to refer to this point again.

Of modern languages, French is of course the most popular—7,572 candidates were examined for certificates in this, as against 2,660 in German. In commercial French there were only eight presentations with four passes. A decided improvement is reported in this division of the work. In commercial German a candidate has for the first time presented himself. On the results of his work he gets a paragraph to himself, mainly of a commendatory character. This is also the case with the solitary candidate who presented himself in Spanish. With reference to this we quote the examiner's report:—

"There are no signs of any growth of interest in this important commercial language."

The chief examiner in French reports:—

"The general impression left on me is that there has been during the past year marked progress in the study of French. Oral methods appear to have been adopted in many schools, and the good effects may be traced in the enlarged vocabulary of many of the candidates, and particularly in the 'free' composition of the lower grade. In the higher grade this improvement is not so clearly marked, and it is important that teachers should realise the necessity of continuing the oral method in the upper classes by questions on the reading-book or conversation. The failures in translation were due as much to want of thought and of general culture as to ignorance of French. Again and again I was convinced in revising the papers that the candidate could not have read the passage through before he put pen to paper, but that he had set himself to his task as though he had so much oakum to pick. In the accidence mistakes were distinctly rarer. In the syntax there was no marked improvement. Evidently the rationale of French moods and tenses is rarely attempted, and even those candidates whose practice was correct were rarely able to give any explanation beyond the rule of thumb. It is to be hoped that the new method (so useful when properly applied) will not displace this most

valuable part of the linguistic training, especially in the case of those pupils who do not get the drill of Latin or Greek syntax."

Referring to the higher-grade paper, the examiner remarks:—

"In the Composition not one per cent. knew the French for 'engineer' or 'dramatist.' Prepositions need very careful attention; 'is with me,' 'a letter for you,' 'with the exception of,' and (still less excusable) 'gone to England,' 'in Spain,' were misrendered by the majority. The translation of short sentences involving some difference of idiom was better done than last year, but still left much to be desired. Common words like 'guest,' 'examination,' 'a rest' were known only by the minority, and the construction of *quand même* and of the preterite anterior by hardly any."

In French composition the examiners find distinct signs of improvement.

On the whole, the report as to the teaching of German is less satisfactory than in the case of French. Its general tone is well summed up in the following extracts from it:—

"There has been no falling off in the quality of the work. If there is no very marked improvement, there are certainly fewer extremely bad papers."

Proceeding from general to particular remarks, the report goes on to say:—

"The knowledge of verbs was seldom really sound. The translation from and into German was of a comparatively simple character, so that lack of vocabulary did not manifest itself in so serious a degree as in the more advanced stages, although the little poem of Goethe proved too hard for many. Revisers, however, complain of many instances of false concords in the composition, of wrong genders, and of mistakes as to the government of prepositions. On the other hand, there was again an improvement in the knowledge shown of the rules for the arrangement of words in a German sentence."

Referring to the honours stage, the examiners find that the number of candidates who deserve special distinction is even smaller than it was last year.

The following remarks on German script may well be commended to the attention of some examining authorities in England, who either do not encourage it, or absolutely forbid it:—

"It seems necessary to emphasise the remarks made last year as to the German script. Seeing that the German character continues to be almost universally used by Germans in writing their language, it is highly desirable that all students of German should be able to read the script with perfect ease. In view of this, an additional allowance of marks continues to be given in all grades for fair German writing. It is now under consideration whether it may not be desirable that, in the near future, we should insist on the German script being used by all candidates in at least the composition part of the papers."

The examiners further report that "almost no schools appear to have yet adopted the reformed spelling, which is now universal throughout the German Empire." We have always thought that far too much has been made of the slight reform in German spelling, which affects only a small minority of the words in the language and suppresses silent letters in some places. That this reform is universal throughout the German Empire is, so far as our knowledge and observation go, an overstatement.

Shortly summarised, the report discloses some very serious deficiencies in the teaching of modern languages in Scotland, while at the same time making it apparent that the tendency is wholly towards improvement. Both England and Scotland suffer under the reproach of spending far larger sums on the teaching of modern languages than do many Continental countries, but with results far and away inferior.

Before closing this short notice we should like to refer again to the first extract we gave from the report. We have for a long time thought that a very great fillip would be given to the better and more practical study of modern languages if the various Government departments which hold examinations in them would make an oral test an integral part of their requirements. The State holds examinations in modern languages for civil servants, teachers, officers in the army and navy, etc., and many secondary and higher schools, and even the universities, lay themselves out to prepare candidates for the Government service. By a stroke of the pen the Government of this country could lead the way in making the teaching of modern languages more practical, at the same time preserving the literary aspects of the teaching. Such a regulation as the one suggested would profoundly affect the teaching of foreign languages in many schools, and would give a necessary lead to the universities and examining bodies. Our suggestion may be perhaps somewhat crude or unpractical. We are at the present only groping in a dim, uncertain way after improvement, but the reforms which are, slowly perhaps, making their way in every department of education will, we are convinced, not allow the teaching of modern languages to remain in its present unsatisfactory state.

DIFFICULTIES OF FRENCH IDIOMS AND CONSTRUCTIONS.

I.

IN the following series of papers we propose to deal with the chief difficulties in the uses of words and idioms and in French construction which the English student is likely to encounter. It must be evident at the outset that these difficulties are not of the same nature as those which would beset a student of some other nationality. The German student of French, for example, is already accustomed to the idea of the agreement of the adjective with its substantive, and the rigid use of the future tense when a single action in future time is referred to is not unfamiliar to him. Nor would his difficulties in the application of particular words in French be the same as those which would puzzle the Englishman. For example, he would be less likely than the Englishman to go wrong in the uses of the verbs *user* and *abuser*, as the corresponding verbs in German are formed from native and not from foreign—that is, classical—roots. Every student of a foreign language starts with some initial difficulties to overcome, arising from the associations of his mother tongue. These have necessarily a strong hold on him, and he can only create the new associations which are necessary to enable him to write and speak the foreign language correctly by constant effort, particularly by diligent reading. The student who commences the study of French after becoming fairly proficient in some other tongue than English, commences with the advantage of realising that he must be prepared to find in that language variations of usage from those in his own language. If he comes across a French word similar in spelling and origin to one in English, he is prepared to reserve his opinion as to the exact use of the word until he has seen it actually at work in a sentence, and gathered from the context what its meaning is. The Latin scholar has a particular advantage in the study of French. He is familiar with the roots of the majority of French words. He easily assimilates the verb terminations, and the use of the subjunctive gives him but little trouble. The agreement of adjective and substantive, the placing of the pronominal direct object before the governing verb, and the agreement of the past participle when used with *être*, are what he would expect in a language which is one of the direct descendants of Latin. Again, if he has read a fair amount of Latin, the ideas of the reflexive use of the verb, and of the agreement of the past participle accompanying *avoir* with the direct object preceding it, will not be new to him. These are but a few of the advantages he will have. Such a student will not derive so much advantage from the following series of papers as would one who is unfamiliar with Latin; but even he will be able to acquire a great deal which will be of use to him. We shall, in the first place, deal with the verbs whose use is open to misconstruction. These we shall endeavour to arrange in alphabetical order. In some cases the verb is used in the English sense, but where it is frequently used in senses strange to us we shall include it in our list.

Abuser is not "to abuse" in the sense of using strong language to a person. *Injurier* would be the best word in this sense. *Abuser* is used in the primary Latin sense of "to make

a bad use of." In this case it is accompanied by *de*. As a transitive verb it means "to deceive." *Il abuse de son autorité. Les sens abusent la raison par de fausses apparences.*

Accuser means not only "to accuse," but is largely used in the phrase *accuser réception de* (*une lettre*, etc.), to *acknowledge* the reception of a letter, etc.

Altérer means not only "to alter," but "to make thirsty." *Du sang de l'innocence est-il donc altéré?* This use of *altérer* helps us to understand the derivative *désaltérer*, which refers only to the second use of *altérer*, given above, and means, consequently, "to slake thirst." *Un agneau se désalterait dans le courant d'une onde pure.*

Assister is mostly used in the sense of "to be present at." "To assist" is usually translated by *aider*. Hence *l'assistance* is "the audience," and *les assistants* "the bystanders." *Nous avons assisté à la réception du roi.*

Attendre is not "to attend," but "to wait for." "To attend," in the sense of "to listen intently," is *faire attention*, and in the sense of "to wait upon," *escorter, accompagner. S'attendre à* is "to expect." *Je vous ai attendu avec impatience.*

Avertir is "to warn," not "to avert." "To avert a blow" is *détourner un coup. Je l'ai averti des conséquences de son imprudence.*

Consommer is not "to consume" in a general sense, but in the particular sense of food or drink. Hence *une consommation* is used specially of a drink of some kind or other obtained in a restaurant or café.

Défier may mean "to defy," but in its reflexive use with *de* it means "to distrust." *Défiez-vous des rois; leur faveur est glissante.* On the other hand, the substantive *défi* has only the meaning of "a challenge." The substantive "mistrust" is *défiance.*

Dresser is not "to dress," which would be translated by *habiller*, but "to set upright." *Il se dresse sur ses étriers.*

Embraser, "to set on fire," must not be confounded with *embrasser*, "to embrace." While the latter is derived from *bras*, "arm," the former is connected with *braise*, "embers."

Filer is not "to file," but "to spin," from *fil*, thread. It is, besides, used in some very idiomatic and expressive phrases. *Les Parques* ("the Fates") *me filaient des jours d'or et de soie.*

Improuver is not "to improve," but "to reprimand" or "not to *approve*." *L'on improuve les médecins et l'on s'en sert.*

Introduire is not used in our sense of causing one person to make the acquaintance of another. In this sense use *présenter*. It is used in the sense of causing some one or something to enter into a place. *Des abus se sont introduits dans l'administration.*

Lancer, it is perhaps needless to say, does not mean "to lance" in a medical sense, but "to throw," "to launch," etc. *Dans la profonde mer Œnone s'est lancée.*

Marier is not "to marry," but "to give in marriage," or, of the officiating clergyman, "to celebrate a marriage." *A-t-on jamais vu un père marier sa fille de la sorte? Le curé les a mariés.*

"Marry," in an active sense, is *épouser*. In a reflexive sense it is *se marier avec* (*quelqu'un* or *une*).

Ménager is not "to manage," but "to use economically." *Il ménage ses forces.*

Prétendre is "to claim," "to intend." "To pretend" is *feindre*, or *faire semblant*. With *à*, *prétendre* means "to aspire to." *C'est à Rome, mes fils, que je prétends marcher. Ils se persuadent facilement qu'il n'y a rien à quoi ils ne puissent prétendre.*

Prévenir is not "to prevent," but "to warn" or "to anticipate some one." *Prévenons Alexandre, et marchons contre lui. Il me prévient de son arrivée.*

Regarder is "to look at." This is, I suppose, the most idiomatic English rendering of the verb, but it contains a trap for the student in that the English verb is followed by a preposition. Hence it follows that beginners in English do not realise that *regarder* is a transitive verb, and insist on putting *à* after it. *Regarder* may be used intransitively with *à*, but in this sense it means "to pay attention to." *Il me regarde du coin de l'œil. Vous devriez un peu mieux regarder aux choses que vous dites.*

Rendre is exactly our verb "render" in the sense of to bring a thing or person into a certain condition, but it also means "to give back," "to *render* up." *Mon intérêt ne me rend point injuste. On peut vous rendre encore ce fils que vous pleurez.*

Succéder is "to succeed" in the sense of "to follow in succession." In the sense of "to achieve success" we must use *réussir*. *Succéder* is followed by *à*. *L'inimitié succède à l'amitié trahie.*

N.B.—We have not translated the sentences used as illustrations. If any of the sentences present difficulties, write to "Editor, *Practical Teacher*," enclosing the coupon of the current number, and marking your envelope outside, "Modern Language Section." *A stamped addressed envelope must be sent for reply.*

FRENCH PRIZE COMPETITION.

RULES.

1. All translations should be **posted not later than October 8**, and addressed:—*Prize Editor*, Office of the PRACTICAL TEACHER, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.

ALTERATION IN RULE 3.

3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

A Prize of Half a Guinea is offered for the best rendering into English of the following extract:—

Mais est-ce bien la vérité tout entière, que les écrivains pessimistes ont montrée? Même dans l'analyse, l'esprit latin reste absolu, il n'a pas le don du relatif; malgré sa souplesse, il fait volontiers ses personnages tout d'une pièce, il les rend trop conséquents dans le mal ou le bien, il synthétise, il catégorise.....Le génie anglo-saxon a beaucoup moins de parti pris; il montre l'homme plus qu'il ne l'analyse, et son respect de l'âme humaine lui interdit d'en découvrir les nudités. Mais s'il a plus de pudeur morale, si ses types restent plus élevés, s'il maintient le *sursum corda* [Lat. "Lift up your hearts." Do not translate.—Ed.] et ne tombe pas dans le pessimisme décourageant, il lui manque cette vaste et large compréhension du cœur de l'homme qui caractérise le génie slave. Ce dernier a tous les courages; dans l'âme d'une courtisane il osera montrer l'éclosion d'une fleur de blancheur et de pureté, et nous verrons l'assassin manifester d'exquises délicatesses de conscience. Aucune contradiction, aucune complexité, ne l'effraie. Les natures les plus tendres et les plus dévouées sont capables, à certaines heures, de pensées dures et violentes; une vie d'abnégation n'empêche pas l'éclosion momentanée d'un criminel désir ou d'une honteuse défaillance. Certes, une tristesse profonde se dégage de cette vue impartiale des grandeurs et des faiblesses humaines, mais l'affirmation que nul être n'est indigne d'être aimé ne dessèche pas le cœur comme la méthode analytique des écrivains latins. La littérature slave ne crée pas le *Hero worship* de la littérature anglaise, mais l'étincelle qu'elle montre brillant dans chaque âme prouve la noblesse des origines de l'homme et empêche de se tarir les sources de l'amour.

MME. DORA MELEGARI.

Study this passage carefully before commencing to translate it. Those whose reading has been fairly wide will be able to see for themselves how far the view of the authoress is generally true by comparing Shakespeare's presentation of Hamlet, Othello, Portia, Cordelia, etc., with the priests, women, and men of business of Balzac, or the characters of Paul Bourget or Edouard Rod on the one hand, and with the characters of the Maslova of Tolstoy's *Resurrection*, or the Raskolnikoff and the Sonia of Dostojeffsky's *Sin and Expiation* on the other hand.

The prize-winner of the July competition ("Zadoc") is Miss M. Wright, Whirstead Road Girls' School, Ipswich.

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Principal of the Belvedere Pupil Teachers' Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

SCHOLARSHIP COURSE FOR 1903.

Tenth Month—October.

(*N.B.*—I should be glad if students who intend to follow this course regularly would send their names and addresses to me.)

Work for the Month.

1. *Reading.*—Finish the reading of *Esmond.*

2. *Repetition.*—This should be now thoroughly known, and we shall not refer to it again. A final caution must be given: mere repetition of words without a proper interpretation of the meaning is quite useless.

3. *Teaching.*—Chaps. xi., xii., *Scholarship School Management:* Object Lessons, Elementary Science, Drawing, etc.

The teaching of these subjects needs careful study, especially by the young student. The question to be asked is, "What is the object of this lesson?" The mere imparting of facts is often taken as being the primary object, and the fundamental object of the lesson, the mental training involved, is frequently lost sight of altogether. The departmental circular on the subject of object lessons should be carefully studied in this connection. The education of the child at school does not consist in making him acquire a certain number of facts, but rather in developing his faculties of observation and reasoning in such a manner that when he leaves school he will have acquired the habit of thought and acquisition of knowledge. Not that the facts learned at school are not useful—far from it—but it is a serious mistake to suppose that this is *all* that a teacher has to attend to; and this is a mistake often made by young teachers. In dealing, therefore, with any of these topics, select such facts as are useful in themselves, and then consider how you can utilise the lesson to develop the power of observation and of correct induction and exact thought. To tell a class that "metals expand when heated," without educing the fact from observation, is to give correct information, but to miss the opportunity of strengthening the observation and reasoning faculties.

4. *Drawing.*—One or two copies each week to fairly fill a half imperial sheet of paper lined in with sepia and brush.

5. *Music.*—Revise any weak points.

6. *Penmanship.*—Ten minutes' daily practice from the *Practical Teacher Copy Book.* This subject needs great attention, judging from the specimens submitted. It is a great mistake to change continually the pen and the style, and to practise without a good copy. Great care in the details is always required.

7. *Composition.*—Write one or two essays each week on such subjects as:—

(1.) Cowper as a poet.
(2.) Free trade and protection.
(3.) Warren Hastings.
(4.) The sea and its wonders.
(5.) Climate and its influence on human progress.
(6.) Birds and their uses to man.
(7.) A rolling stone gathers no moss.
(8.) The general moral to be learned from the "Heroes."

The following notes may give some idea of the line to be taken.

(1.) The introduction to your text-book will probably help in this. Note that Cowper stands midway between the Augustan Age of Queen Anne and the Lake School. His descriptions of nature are vivid, and are evidently the work of a keen observer. Note also his widespread sympathy with the poor and with animals.

(2.) Take the arguments for and against.

(3.) Read Macaulay's brilliant essay on this subject.

(4.) This should present no difficulty at all.

(5.) Character as influenced by climate. Polar cold stunts physical and mental growth—all life one struggle for food. Tropical heat enervates—abundance of natural food, no necessity to work; hence no energy or forethought. It is in the temperate zones where all the powerful nations are found, and where the highest type of man exists. Here the conditions are such that thrift, prudence, invention, etc., are called into play. While considerable time is expended in work, sufficient leisure is left for recreation and mental culture, as evidenced by the wealth of literature.

(6.) Little need be said on this. Apart from the cheering influence of the singing-birds and the uses for food, etc., birds play a very important part in the economy of nature by keeping down the insect world, which otherwise would become a serious plague.

(7.) Treat this as other proverbs—literally, and then generally, as applicable to everyday life. Discuss the truth of it; compare with other proverbs—"Nothing venture, nothing have," etc.

(8.) This is touched on in the last paragraph of the book. Men are dependent on the gods. If they do right, they prosper; if they incur the displeasure of the deities by wicked actions, punishment inevitably follows. This can be instanced from all the tales.

8. *English.*—

(1.) Learn twenty-five roots and meanings per week.
(2.) Revise thoroughly prefixes and affixes.
(3.) *The Task*, Book V., lines 305–330.
(4.) *As You Like It*, Act V., Scenes ii., iii., and iv.

Notes on "As You Like It."

Act V., Scene ii.—Orlando's wonder at his brother's falling in love at first sight is very delightful, if we consider that he has seen less of Rosalind than his brother has of Celia. The sudden change in Oliver's character is quite natural. At home, as the master, he is selfish and haughty; now banished, and a lover, he becomes much more humble. His gratitude to his brother is also a cause for the change of tone.

Fair sister. As Rosalind is still in boy's attire, Oliver either is entering into the jest that Rosalind is assuming the *rôle* of his brother's sweetheart, or Celia has enlightened them as to the real facts of the case. But this latter supposition is hardly likely.

Did your brother tell you? etc. Rosalind is evidently anxious to know whether her fainting has betrayed her secret.

Cæsar's thrasonical brag. His dispatch to the senate after the battle of Zela, B.C. 47: *Veni, vidi, vici*—"I came, I saw, I conquered."

Clubs cannot part them. A reference to the old custom of calling out the London citizens and apprentices with their clubs to part fighters in the London streets.

By so much the more. "My happiness at my brother's joy will be equalled by my misery at my own unhappy state."

Of good conceit, of good understanding, with plenty of common sense, one who will understand what I am going to say.

A magician, and yet not damnable. To claim to be a magician was to render oneself liable to death for dealing with the black art.

Howling of Irish wolves, all crying the same thing together; baying in a chorus.

Scene iii.—*A woman of the world*—that is, a married woman. Unmarried women were not allowed to move about then as freely as they do now.

Untuneable. Touchstone probably means that their voices did not harmonise; hence his remark, "God mend your voices."

Scene iv.—*As those that fear they hope, and know they fear*, as those that fear that they have set their hopes on what is unattainable, and are only too conscious that they fear their hopes will never be fulfilled.

Desperate, daring, bold; referring to Rosalind's claim to a knowledge of magic.

Motley-minded, his mind matches his dress, being composed of great contrasts.

Undone three tailors, ruined them by not paying—a standing joke of the times.

Foul oyster, ugly, ill favoured.

Be seven times removed. The whole of Touchstone's discourse on quarrelling is evidently sarcastic on the manners of the times.

Still music = soft music.

Atone, are *at one;* agree.

Addressed, made ready, prepared.

Every of this number, every = each one, used as a pronoun by Shakespeare.

9. *Geography.*—(1) British Possessions in Polynesia; (2) revise South America.

(1.) Fiji consists of 200 to 250 islands, with a total area of about 7,500 square miles, and a population of 120,000. The principal islands are Viti Levu and Vanua Levu. Productions (remarkably luxuriant)—bread-fruit tree, banana, plantain, peanuts, yams, cocoa-nuts, sugar-cane, tea, cotton, maize, tobacco, arrowroot. Chief exports—pearl shells, copra, *bêche de mer*, vanilla. The islands were annexed in 1874. Capital, Suva. Government—a crown colony.

(2.) *British New Guinea* comprises the southern and south-eastern shores of the island, about 90,000 square miles, with a population of 150,000. Taken over as a protectorate in 1884, and four years later constituted a colony. Most of it is forest clad, but little trade is at present done. Samarai and Port Moresby are the chief settlements.

(3.) Islands in the Pacific. There are many groups, the chief of which are:—

(*a*) British Solomon Islands—a protectorate. Value of exports about £29,000. Seat of government, Tulagi.

(*b*) Gilbert and Ellice Islands Protectorate. Twenty-five islands, with a total area of 166 square miles. Population, 35,000.

(*c*) Tonga or Friendly Islands. Area, 385 square miles. Population, 20,000. Value of imports, £75,000 per annum.

(*d*) The Phœnix Islands, seven in number.

(*e*) The Union or Tokelau group.

Questions on South America (selected from Examination papers).

(1.) Describe with a sketch map the valley of the Amazon or the Orinoco.

(2.) Where and what are the Pampas, Llanos, Selvas, and El Gran Chaco?

(3.) Describe the mountain system of South America.

(4.) What articles are imported and exported at Rio de Janeiro, Demerara, Buenos Ayres, Valparaiso, Callao?

(5.) Say what you can of Venezuela.

(6.) Give some account of the animals peculiar to South America.

(7.) From what part of South America do we get cocoa, coffee, diamonds, tinned meats, silver, and nitrates?

(8.) Give in a tabular form the states of South America, their capitals, government, and chief ports.

10. *History.*—George the Third, 1783, to William the Fourth, 1837.

The second half of George the Third's reign was occupied mainly with the great struggle with France, which cost England thousands of men and added £600,000,000 to the National Debt.

The causes of the French Revolution must be clearly understood; read Carlyle's *French Revolution* for this. The attitude of the republic towards Holland led to war, which the ambition of Napoleon continued for twenty years. It is interesting to trace how the plans of the emperor were overthrown by the British. It was English money and Pitt's genius which kept the Continent from falling entirely under the sway of the French. Napoleon's first great scheme—to found a French empire in the East—was frustrated by the destruction of his fleet at the battle of the Nile. His plan of invading England was twice defeated—(1) by Nelson seizing the Danish ships; and (2) by the battle of Trafalgar, which, by destroying the fleet intended to cover the passage of the Channel, ended all fear of invasion. The forced abdication of the King of Spain, and the invasion of Portugal for not putting into effect the Berlin Decrees, led to the Peninsular War. The success of Wellington was the deathblow to French supremacy in Europe. "It was the Spanish ulcer which destroyed me," was Napoleon's remark. The Peninsular War must be carefully followed. It was not a march over for the English, but a keen contest of military genius, in which Wellington proved himself always the superior.

The "Hundred Days" and the battle of Waterloo must be fully understood. Learn a plan of the latter. The results of the war were serious. To meet the interest on the enormous debt heavy taxation was necessary; harvests failed; the Corn Laws forced up the price of wheat to 80s. a quarter; the introduction of labour-saving machinery before a market had been found to take the increased production caused acute distress; and the three or four years following Waterloo were the gloomiest in the century. Note also the Irish Union, the war with the United States, affairs in India.

George the Fourth.—The chief points in this reign are—

(*a*) The Cato Street Conspiracy, an attempt to initiate in England a revolution such as had taken place in France: failed because the circumstances were altogether different.

(*b*) The war with Turkey: battle of Navarino, and emancipation of Greece.

(*c*) The Catholic Emancipation, which deserves special note. The Catholics were practically deprived of all their civil rights by the severe statutes against them, and they had been expressly excluded from the Toleration Act of William the Third.

William the Fourth.—The great Reform Bill is very important. The text-book will probably give all details. The Reformed Parliament justified the change by the passing of the Slavery Abolition Bill, the Factory Act, the Poor Law Amendment Act, the Municipal Corporation Act, and the Marriage Act. Each of these removed a serious abuse.

Exact details of the Reform Bill must be known—for example, the number of places wholly or partly disfranchised, and the manner in which the seats were redistributed.

11. *Arithmetic.*—(1.) Next 100 sums in the general examples (Christian and Collar). (2.) Square and cube root, and their application.

12. *Algebra.*—Ratio and proportion.

13. *Euclid.*—Revise the second half of Book I., with ten deductions per week.

14. *Science.*—The preparation, properties, and chief compounds of the common metals—lead, copper, tin, gold, silver.

15. *General Information.*—Work through several papers in one of the books of questions used.

Notes on the August Paper.

1. Fairly well done. Many students failed to notice many of the institutions which took their rise in Christianity. The "Golden Rule" was a new thing in religion, and hence hospitals and orphanages, etc., justice tempered with mercy, the emancipation of woman from a state of slavery.

2. The arguments for and against vivisection were generally given correctly and concisely. If it can be proved that by vivisection the human race benefits largely, it is justifiable; otherwise not. The onus of proof rests with those who uphold the usefulness of the practice.

3. The terms were all known in most cases.

4. Well answered.

5. The figures of speech were—(*a*) Apostrophe, (*b*) synecdoche, (*c*) personification, (*d*) metonomy, (*e*) metaphor, (*f*) simile, (*g*) hyperbole.

6. Many confused ideas exist (quite naturally perhaps) as to the proposed alteration in our fiscal system. Some answers were very good. The question is not one of *right* and *wrong*, but of future benefit to the nation financially, and in its relations with foreign powers. Will the increased price of food, etc., be compensated for by increase of trade and general prosperity? That is the question, and one which cannot be answered definitely.

7. Generally well done. *Idiot*, originally a private person, one who took no part in the government of Greek cities and communities. As such were rare and usually of deficient ability, the word acquired its present meaning. *Sincere* = *sine cera* = without wax, applied either to honey clear from the wax, or to pottery in which cracks were filled with wax, etc.; hence free from any hidden defect. *Charity* = *charitas* = brotherly love, now limited mainly to almsgiving.

8. St. Paul's dictum was generally quoted on this point, but it was and is a common custom in Eastern countries, where women are generally guarded with great jealousy.

Test Questions on General Information.

The answers to these questions are marked gratis. They should be written on foolscap, and on one side only; the coupon of the present number and a stamped addressed envelope must be enclosed. All papers must be sent direct to Mr. A. T. Flux, Oakleigh, Belvedere, Kent. A prize of one guinea will be given

to the student securing the highest percentage of marks on the course.

1. Mention ten famous pictures and their painters.

2. Who wrote the following? State very briefly the object (if any) of the work:—*Wealth of Nations, Alton Locke, Utopia, Areopagitica, All Sorts and Conditions of Men, Looking Backward, Essay on Man.*

3. What are the principal classes into which animals are divided?

4. What do you know of the Escurial, the Tomb of Mahomet, the Parthenon, the Pillars of Hercules, the Great Lone Land, the Taj Mahal?

5. Explain the following:—Facsimile, alibi, Renaissance, lyddite, Cortes, centre-board, grafting.

6. Give the origin of the following names:—Virginia, San Francisco, Duluth, Adelaide, Tasmania, New Zealand, Jamaica, Natal, Liberia.

7. What is a comet? What would happen if the earth ran into one in space?

8. What is a moose, a lemming, a cheetah, a marmot, a mongoose, an armadillo, a kestrel, a skunk, a lemur?

Examination Questions on "As You Like It."

(*For Revision Purposes.*)

1. From what source did Shakespeare draw the plot of this play? Mention some points in which he deviated from that source. Can you account for the deviations?

2. Give (*a*) the equivalents in modern English of *character* (verb), *defy, nice, alone, foul;* (*b*) the meaning of *leer, thrasonical, bandy, puisny, curtle axe, pantaloon.*

3. *As You Like It* has been called a play of country life. Illustrate this by briefly describing the characters of (*a*) Touchstone, (*b*) Phebe, (*c*) Audrey.

4. "All the world's a stage,
And all the men and women merely players."
Was this comparison originated by Shakespeare? Why is it specially appropriate in the mouth of Jaques?

5. Explain the construction of the phrases, Come your ways, Thou wert best look to't.

6. Point out and explain any grammatical peculiarities in the following passages:—

(*a*) "Alas, poor shepherd! searching of thy wound,
I have by hard adventure found mine own."

(*b*) "But didst thou hear without wondering how thy name should be hanged and carved upon these trees?"

(*c*) "If this be so, why blame you me to love you?"

7. Briefly describe the peculiarities of Shakespeare's blank verse. Mark the accent and feet in the following verses:—

(*a*) "His acts being seven ages. At first the infant."

(*b*) "And get you from our court. Me, uncle? You, cousin."

(*c*) "Than in their countenance. Will you hear the letter?"

8. Explain:—

(*a*) Dead shepherd, now I find thy saw of might,
"Who ever loved that loved not at first sight?"

(*b*) He that a fool doth very wisely hit
Doth very foolishly, although he smart,
Not to seem senseless of the bob: if not,
The wise man's folly is anatomised
Even by the squandering glances of the fool.

(*c*) I sometimes do believe, and sometimes do not;
As those that fear they hope, and know they fear.

(*d*) You are full of pretty answers. Have you not been acquainted with goldsmiths' wives, and conned them out of rings?—Not so; but I answer you right painted cloth, from whence you have studied your questions.

9. Quote any one of the lyrics in the play.

10. Write out a list of *dramatis personæ* in the play. What character is Shakespeare himself said to have performed?

Test Questions.

1. *Penmanship.*
Large Hand.—*Pythagoras.*
Small Hand.—*Most friendship is feigning, most loving mere folly.*

2. In giving a lesson on Monmouth's rebellion, what facts would you make most important, and how would you try to teach them?

3. Write an essay on *As You Like It.*

4. Analyse the following, and parse words in italics:—

"*Thus* by degrees, *self-cheated* of their sound
And sober judgment, *that* he is *but* man;
My demi-deity, and fume him *so*,
That in due season he forgets it *too*."

5. Quote examples of blank verse, heroic measure, iambic pentameter, iambic tetrameter, dactylic dimeter. Mark the accents.

6. Under what circumstances was New Zealand annexed? How is it governed? Say what you can of the productions of South Island.

7. What do you know of the trade and towns of Mexico?

8. Give an account of Walpole's Excise Bill, and write an estimate of his character.

9. Why is 1759 sometimes called "The most glorious year England has ever seen"?

10. Work the following:—

(1.) A sum of money was divided among three persons—A, B, and C. A and B together got £18, 19s., A and C together, £17, 13s. 6d., and B and C together, £15, 12s. 6d. What was the sum, and what did each get?

Ans. £26, 2s. 6d. A, £10, 10s.; B, £8, 9s.; C, £7, 3s. 6d.

(2.) In what time will £2675, 4s. 2d. amount to £3036, 7s. $2\frac{1}{2}$d. at 6 per cent. per annum simple interest; and what sum would it have amounted to at compound interest in the same time?

Ans. $2\frac{1}{4}$ years; £3050, 19s. 0d. ·4907.

(3.) How much carpeting 45 inches wide will be required to cover a room 36 feet 8 inches by 18 feet 4 inches with a recess 12 feet square opposite to one of the longer sides? What will it cost at 4s. 2d. per yard? Ans. $72\frac{2}{3}\frac{2}{3}\frac{2}{3}$ yards; £15, 2s. $3\frac{3}{11}$d.

(4.) What is the clear annual income derived from investing £6050 in the 3 per cents. at $90\frac{3}{4}$ after deducting an income tax of 4d. in the £? Ans. £196, 13s. 4d.

11. Write the following in staff notation:—

Key G. | d :-.r | m.f:s | s,l,s:f.,m | r :d |

12. What are the chief constituents of coal gas? Describe briefly how it is prepared.

E.R.J.—The solution is as follows:—

Question. Six horses and eight cows cost £375. They are sold at £446, 5s., making a profit of 25 per cent. on the horses and 10 per cent. on the cows. What was the average cost of each horse and each cow?

Solution. The gain = £446, 5s. − £375 = £71, 5s.
$\frac{1}{4}$ of cost price of horses + $\frac{1}{10}$ cost price of cows = £71, 5s.
∴ cost price of horse + $\frac{2}{5}$ cost price of cows = £285.
And cost price of horse + all cost price of cows = £375.
Subtracting $\frac{2}{5}$ cost price of cows = £90.
∴ all cost price of cows, £150 = £18, 15s. each.

PUPIL TEACHERS' COURSE.

For Candidates' Examination, 1904.

1. *Reading and Repetition.*—Continual oral practice is very necessary, great care being taken with enunciation and modulation.

2. *Penmanship.*—Ten minutes' practice per day from the *Practical Teacher Copy Book.* The acquisition of a thoroughly good and rapid style of writing is very important for future success.

3. *English.—The Elegy*, verses 21–24. Analyse and parse the whole. Learn meanings of all allusions and derivations of the chief words.

Line 81. *Name* and *years* form the subject of *supply.*

84. *Moralist to die* is the object of *teach*, this being a verb which usually takes a double object.

85. *Prey* is in apposition with *who.*

87 and 88. Supply *who* as the subject.

91. *E'en* = adverb of emphasis, modifying the phrases *from the tomb* and *in our ashes.*

93. *For thee* belongs to *may say* in line 97.

95. *Chance* = perchance; adverb of doubt, modifying *shall inquire.*

Led, perfect participle, qualifying *spirit.*

96. *Some*, indefinite demonstrative adjective, limiting *spirit.*

4. *Arithmetic.*—Problems on fractions.

A common type of these is—A boy spends $\frac{1}{2}$ his money, then $\frac{2}{3}$ of the remainder, then $\frac{1}{4}$ of what then remained, and has 1s. 4d. left. What had he at first?

Solve thus:—

He spends $\frac{1}{2}$ his money, ∴ he has $\frac{1}{2}$ left.
He spends $\frac{2}{3}$ of $\frac{1}{2} = \frac{1}{3}$ his money, ∴ he has $\frac{1}{4}$ of $\frac{1}{2}$ left $= \frac{1}{8}$.
He spends $\frac{1}{4}$ of $\frac{1}{3} = \frac{1}{12}$ his money, ∴ he has $\frac{3}{4}$ of $\frac{1}{3}$ left $= \frac{1}{4}$.
Now $\frac{1}{4}$ = 1s. 4d.,
∴ $\frac{1}{8}$ (or the whole) = 10s. 8d.

Many candidates get these sums wrong through not deciding clearly at each step what is *spent* and what is *left*.

5. *Geography.*—Physical features, climate, and productions of Scotland.

Draw a good map, insert names of all places to be mentioned, and repeat till thoroughly known. Notice the effect of the climate and soil on productions. All these points are very well set out in the text-book.

6. *History.*—Henry the Eighth to James the First, 1625.

Points requiring special attention:—

Henry the Eighth.—Life of Wolsey; the divorce question; the Reformation, its causes, course, and effects; dissolution of the monasteries; battle of Flodden; Sir Thomas More.

Edward the Sixth.—Progress of the Reformation; Somerset and Northumberland; battle of Pinkie; Ket's rebellion.

Mary.—Lady Jane Grey; Wyatt's rebellion; the persecution.

Elizabeth.—Mary Queen of Scots; the Spanish Armada; the Irish rebellion; the great men of the reign—Cecil, Raleigh, Drake, Sydney, Hawkins, Essex, etc.

James the First.—His descent (learn a genealogical table); the plots (Main and Bye, Gunpowder); Hampton Court Conference and new translation of the Bible; growth of the Puritan party and quarrels with Parliament.

Each of the above points must be clearly understood.

7. *Elementary Science.*—The pulley, the inclined plane, and the screw.

Distinguish carefully between the mechanical advantage in a single fixed and single movable pulley, and be prepared to draw diagram of these and of the three systems of pulleys.

8. *Music.*—Work any back questions.

Questions on Last Month's Work.

1. Analyse and parse words in italics.

> "*Yet e'en these* bones from insult *to protect*,
> Some frail memorial *still* erected *nigh*,
> With uncouth rhymes and shapeless sculpture *decked*,
> Implores the passing tribute of a sigh."

2. Write an essay on advertisements, their use and abuse.

3. Work the following:—

(1.) What fraction of $5\frac{3}{4}$ of $1\frac{7}{9}$ of 7s. 1d. is $\frac{5\frac{1}{6} - 3\frac{1}{4}}{3\frac{3}{8}}$ of 15s. $11\frac{1}{4}$d.?
Ans. $\frac{1}{4}$.

(2.) Express £$\frac{3}{5}$ − $\frac{3}{17}$ crown + $\frac{3}{8}$ shilling as the fraction of $\frac{4}{17}$ guinea + $4\frac{1}{3}$ florins. Ans. $\frac{3}{5}$.

(3.) Find the value of $\frac{4}{5}$ of $\frac{1}{7}$ of $1\frac{4}{9}$ of $1\frac{3}{5}$ of 494 guineas.
Ans. £102, 19s. $2\frac{2}{3}$d.

(4.) Find the difference between

$$\frac{\text{£2, 17s. 6d.}}{\text{£12, 18s. 9d.}} \text{ and } \frac{\text{2 cwt. 2 qrs. 10 lbs.}}{\text{12 cwt. 0 qrs. 19 lbs.}}$$ Ans. $\frac{1}{4}\frac{1}{3}$.

4. Describe the basin of the Thames. Say what you can of the industries of Wales.

5. Draw a map of Wales, and mark in Llandaff, Dolgelly, Llandudno, Carnarvon, Swansea, Newtown, Aberystwith.

6. What do you know of Joan of Arc, Warwick the king-maker, and Cardinal Morton?

7. Explain as clearly as you can the causes of the Wars of the Roses.

8. Explain with a diagram why the earth moves round the sun, and neither flies off into space nor rushes into the sun.

First Year.

1. *Reading and Repetition.*—Plenty of careful oral practice is very necessary.

2. *Penmanship.*—Ten minutes' daily practice from the *Practical Teacher Copy Book*. The subject requires continual care.

3. *English.*—Cowper, *Expostulation*, lines 187–220; or *The Task*, Book V., lines 187–219.

Paraphrase and analyse the whole, and parse any word presenting difficulty. Learn the derivation of all the important words. From fifteen to twenty-five roots should be learned regularly every week.

4. *History.*—Henry the Seventh and Henry the Eighth.

Henry the Seventh's ways of raising money:—

(1.) By obtaining subsidies for wars (1488–1492) which were evaded.

(2.) By revoking the grants made to the House of York.

(3.) By confiscations and fines after revolts.

(4.) By benevolences. (Morton's fork.)

(5.) By fines for breaking obsolete statutes upon the information of Empson and Dudley.

(6.) By fines exacted by the Star Chamber.

(7.) By marriage dowry of his daughter-in-law.

Note.—The rising against the king, and the causes of his absolute sway. (Decay of the old nobility, wealth, personal character, possession of only artillery in the kingdom, etc.).

Henry the Eighth.—Wolsey's career. The question of the divorce. The breach with Rome. Suppression of the monasteries and subsequent distress (*v.* Pilgrimage of Grace). The Six Articles. Battle of Flodden. The Reformation—causes, course, effects—must be carefully studied. Note that Henry was *not* a reformer.

5. *Geography.*—Asia. Climate, productions, and Russian Asia in detail. Sketch-maps must be freely used. Note particularly the Siberian Railway and the Trans-Caspian Railway.

6. *Arithmetic.*—Simple interest. Work by method of unity, and *not* by formula.

7. *Science.*—Revise the subject of light.

8. *Euclid.*—Props. 21–24, with three deductions per week.

9. *Algebra.*—Division.

Test Questions.

1. Analyse one of the following, and parse words in italics.

(*a*) "*What* nation will you find *whose* annals prove
So rich an interest in almighty love?
Where dwell they now, *where dwelt* in ancient day,
A *people* planted, watered, *blest as they*."

(*b*) "Long wavy wreaths
Of flowers, that feared no enemy *but warmth*
Blushed on the panels. *Mirror needed none*
Where all was vitreous."

2. Give some account of the advance of the Constitution under the Lancastrians.

3. How do you account for the loss of the French province in the reign of Henry the Sixth.

4. Explain the mountain system of Asia.

5. Describe the course of one river flowing into the Arctic, of one into the Pacific, and of one into the Indian Ocean.

6. How would you trisect a right angle? Prove that your method is correct.

Second Year.

1. *Reading, Repetition, and Penmanship.*—Regular daily practice in these subjects must be taken.

2. *Geography.*—South America. Draw exact maps in note-book of all the countries studied.

For questions on this subject, see Scholarship Course.

3. *History.*—George the Fourth and William the Fourth.

For chief points, see Scholarship Course.

4. *English.*—Milton's *Paradise Lost*, Book III., lines 476–555. Be prepared to analyse or paraphrase any part and parse any word.

5. *Arithmetic.*—Measurement of areas. Chap. xlviii. (Christian and Collar).

6. *Elementary Science.*—Finish magnetism thoroughly.

7. *Mathematics.*—Students must write for assistance in any difficulty.

Test Questions.

1. *Penmanship.*—Large Hand—*Philosophically.*
Small Hand—*Thus with the year seasons return.*

2. Give some account of the vegetable productions of the West Indies. How do you account for the decrease in the sugar crop?

3. Describe with a sketch-map the course of the Nicaraguan Canal.

4. Point out what part England had in defeating the schemes of Napoleon.

5. What were the Berlin Decrees? What effects did they produce?

6. Analyse the following, and parse words in italics:—

> "*As when* a vulture on Imaüs bred,
> Whose snowy ridge the roving Tartar bounds,
> *Dislodging* from a region *scarce* of prey,
> *To gorge* the flesh of lambs or yeanling kids
> On hills where flocks are fed, flies toward the springs
> Of Ganges, or Hydaspes, Indian *streams;*
> But in his way lights on the barren plains
> Of Sericana, where Chineses drive
> With sails and wind their cany waggons light:
> *So* the fiend walked up and down."

7. Explain the allusions in the above.

8. Give some experiments to prove magnetic induction.

9. Write a short essay on nature study.

OUR CERTIFICATE COURSE FOR 1904.

BY GEORGE COLLAR, B.A., B.SC.,

Head-master of the Stockwell Pupil Teachers' School.

TEST QUESTIONS ON LAST MONTH'S WORK.

Theory of Teaching.

1. What are the tests of good reading? Discuss the importance and usefulness of (*a*) pattern reading, (*b*) silent reading, (*c*) simultaneous reading. (Cert.)

2. What steps would you take to ensure proper phrasing in the reading lesson?

English Language and Literature.

1. Describe briefly *either* the entry of Queen Elizabeth into Kenilworth, *or* the journey of Amy Robsart from Cumnor to Kenilworth.

2. Give some account of the part played in the story by *three* of the following characters—Michael Lambourne, Alasco, Giles Gosling, Sir Walter Raleigh, the Earl of Sussex.

3. Explain the following words and phrases—*Paris Louvre, chattels and my movables, the golden earnest, finely bolted, capital crimes, he is footed.*

English History.

1. What was the extent of the empire of Henry the Second, and at what periods were his various foreign possessions lost by England?

2. State the questions at issue between Henry and Becket, and show how far they were solved by the Constitutions of Clarendon.

3. Write an account of two of the following—Hubert de Burgh, Simon de Montfort, Stephen Langton.

Geography.

1. Give three examples of historical facts which cannot be properly understood without a knowledge of the geography of the countries in which they occurred.

2. Give an account of the chief productions of Italy.

3. Name some of the chief kinds of wine imported into this country, and say where they come from.

Arithmetic.

1. Prove from first principles that $\frac{3}{4} - \frac{5}{8} = \frac{1}{8}$, and justify in this case the ordinary process for subtraction of fractions.

2. Why is the L.C.M. of the two denominators used in addition and subtraction of fractions in preference to any other multiple?

3. Without actually subtracting one fraction from the other, show that the difference between $\frac{99}{100}$ and $\frac{77}{78}$ is greater than $\frac{1}{100}$.

Algebra.

1. Find the factors of $xy + z^2 - xz - yz$.
Hence, or otherwise, simplify

$$\frac{a+b}{ab+c^2-ac-bc} + \frac{a+c}{ac+b^2-ab-bc} + \frac{b+c}{bc+a^2-ab-ca}.$$

2. Find the factors of

$$(x-2y+z)^3 - (y-2x+x)^3 + (z-2x+y)(2z-x-y).$$

3. Simplify the expression

$$\frac{a^2-b^2-c^2+2bc}{a-b-c} \times \frac{b^2-c^2-a^2+2ca}{b-c-a} \times \frac{c^2-a^2-b^2+2ab}{c-a-b}.$$

Euclid.

1. Describe a square equal to a given rectilineal figure. A square and a rectangle are equal in area, prove from the figure of the above proposition that the perimeter of the square is less than that of the rectangle.

2. A straight line AB is bisected in C; show how to find a point D in AB produced such that the rectangle contained by AD, DB may be equal to the square on BC.

Elementary Science.

1. Some red oxide of mercury is heated in a dry test-tube, and in a short time it is observed that a deposit is formed some way up the test-tube. Of what is this deposit composed? State exactly the circumstances which have led to its formation. (Cert.)

2. Explain the conditions which lead to the formation of moisture and ice on the inside of window panes. What difference will an open window make to these appearances? (Cert.)

NOTES AND SYLLABUS FOR OCTOBER.

English Composition.

Study carefully Nesfield's *English Composition*, chapters viii. and ix. A careful perusal of these will soon convince the reader that there is a great difference between "writing" and "writing well." And easy as it may seem to write down a sentence, the reader will be convinced that there is great art in writing a passage in its best form. These chapters form such a systematic treatment of the subject that it seems impossible to add to them.

Prepare essays on the following subjects:—

1. The use and abuse of strikes.
2. The existence of powerful states as a guarantee of peace.
3. Old age pensions.
4. The connection between a writer's style and his training.

Theory of Teaching.

Study the methods of teaching spelling as set out in the eighth chapter of the text-book.

The student is required to deal with "Instruction of younger children, based on a knowledge of the principles of Froebel," and is recommended to read Herford's *Froebel*. We propose therefore to give a short account of these principles, and shall deal with the book itself next month.

The chief principles laid down by Froebel are:—

1. Education must be founded on a *religious* and on a scientific basis.

2. All true education must be *connected* and *continuous*. If the teacher works systematically, the education of the child will be progressive.

3. Educational treatment must be applied to each individual child, and *must call forth and guide his self-activity*. Its object must be to develop the latent powers of the child.

4. The teacher must take into account the two very important factors in the child's development—namely, *heredity* and *environment*.

5. The true educator will never separate training and instruction, but will select subjects for instruction which help in the building up of character.

We have stated these principles together, but will comment on them individually.

1. Such a narrow meaning is frequently given nowadays to the term "religious teaching," that Froebel's first and fundamental principle is apt to be misunderstood. Froebel desired that all children should be taught the Word of God; but by that he did not mean a denominational formula, or even simply the Bible. Following the definition given by our Lord Himself in John xvii. 17—"Thy word is truth"—Froebel taught that all truth is God's word, and that the child's simple inquiries about natural objects were searches after God. With this wide conception of religion, Froebel did not advocate the teaching of religion as a thing apart, but as that which gave life and purpose to every subject adopted in the curriculum, and which would enable the child to fulfil the purpose of his existence, which he summarised as "to gain a clear knowledge of himself, to be at peace with nature and at one with God." The first care, then, of the teacher is to lead his children to a pure and holy life by developing right habits of thought and action, and making the practice of religion the rule of daily life.

2. It seems remarkable that an educational reformer should ever have been needed to point out that it was wrong to attempt to teach in scraps, and that the proper way to educate was to correlate the different parts of the work. In the moral training we must recognise the fact that the child passes through definite stages—doing what is right, first in order to please its parents, perhaps to avoid punishment, and proceeding through many degrees of consciousness of right until the right principles are firmly grounded. Quite of late years, and under conditions which allow the individual teacher more freedom in arranging the curriculum, much has been done in following out Froebel's ideas on the correlation of studies: thus an object lesson on milk is followed by one on butter, one on cheese, etc., while the songs and games illustrate dairy work and cows. So, if the lesson has been on cherries, pictures of cherries or the fruits themselves are used in the number lesson.

"Word-building" has arisen from a recognition of the fact that words are most easily learned, not as separate things, but through their relation one to another.

3. The third principle stated above is a recognition of the fact that there is in every child more or less of *self-activity* or spontaneousness. In most children there is an abundance of this, and Froebel tells us that this should not be repressed so as to keep children quiet, but should be utilised as the chief motor force in shaping the education of the child. One great attribute of God is His creative power, and the natural desire of children *to produce*

something is a manifestation of that creative activity in which, when benevolently applied, man most resembles his Maker. It should be noticed that the activity of children should not be that of machines or missiles driven by some force from without, but rather it should mark the early stages of intelligent action, and it must be so made by the teacher to react on itself that the intelligence of the children may be developed. It is intelligence which prompts the actions, and the actions should be so guided and controlled that they may improve the intelligence. The more the child grows in intelligence the more definite and more clearly directed to an object will be the activity, and the more carefully and systematically the objects are presented to the child the more will his intelligence grow. Hence Froebel arranged a series of "gifts," or sets of objects, for bringing this *self-activity* of the child under ordered and systematic treatment. There were originally seven gifts, as follows:—

First gift, the ball, or box of balls. This consists of a number of balls of worsted of the same size but of different colours. The ball was chosen for the first gift on account of its simplicity, and its perfect symmetry leaves very little to be said about its parts. This gift is used in teaching colours, properties such as hardness or softness, and direction (up and down, right and left).

Second gift, a box containing a sphere, cylinder, and cube. With this the child is taught to contrast geometrical forms, to observe the parts of an object.

Third gift, or first building box. This consists of a large cube divided into eight smaller cubes. It is useful in teaching number, and the child can arrange the cubes so as to construct a large number of forms.

Fourth gift, or second building box. This consists of a cube divided into two in one direction, and four in another, so as to form eight bricks in which the length is twice the breadth, and the breadth is twice the thickness. This enables the child to avail itself of the differences in the dimensions of the blocks in forming different patterns.

Fifth gift, or third building box. This is really an elaboration of the fourth gift. A large cube is divided into twenty-one whole cubes, six halves, and twelve quarters.

Sixth gift, or fourth building box. This again is a divided cube, but the divisions afford opportunities for making other combinations.

Seventh gift. This consists of five boxes of thin pieces of coloured wood, in the form respectively of squares, right-angled isosceles triangles, equilateral triangles, right-angled scalene triangles, and obtuse-angled triangles. The educational combinations possible with these are practically infinite.

Following the same principle, many other kindergarten gifts have been introduced, so that the *self-activity* of the child may be exercised on stick-laying, stick-plaiting, pattern pricking, paper-folding, paper-cutting, cardboard-work, drawing, embroidery, and modelling.

4. Froebel rightly contends that to educate the child aright it is necessary to consider his relation to the rest of the human race, and the two most important ways in which this relation affects education are by *heredity* and *environment*. By the former we denote the tendency that the child has to resemble its parents or ancestors. If the teacher were perfectly cognisant of the characters of a child's parents and ancestors, he would know practically all about the natural tendencies of the child. But he can only generalise and conclude that the factors which have influenced education in times past will have an influence now. Moreover, there is always a close resemblance between the way in which an individual pupil acquires a knowledge of any particular subject, and the way in which the whole sum of information on that subject has been acquired by men at large (see *Collar and Crook*, pp. 73, 74); hence it is important that the teacher should, as a rule, know something of the history of the subject he is dealing with. But we must consider not only the tendencies with which a child is born, but also the *scope* afforded to those tendencies by the child's surroundings or *environment*. Froebel laid great stress on this, and following the philosophy of Locke, showed how the child, like a "suckling babe," was continuously drinking in the impressions made by its surroundings, and using them as so much mental food. He speaks of environments as of three kinds: (*a*) *Natural environment*, by which he meant the natural objects—flowers, trees, animals, air, etc.—by which the child is surrounded; (*b*) *social environment*, or the human beings with whom the child is brought into contact, especially the family at home, and teacher and schoolfellows at school; (*c*) *Divine environment*, including all those attendant circumstances which purified and elevated his mind and developed his higher nature. The classification is not a logical one, because the third is made up of the best and noblest parts of the other two. The duty, however, of teachers is evident. So far as it is possible, the school should be a place where the children have bright and happy surroundings, and these will largely co-operate with the oral lessons given by the teacher in the true education of the child.

5. The reader has often heard the difference between *education* and *instruction* pointed out. The difference is great, it is true; but Froebel pleads that they shall not be separated—that instruction shall be the instrument by means of which we educate. Instruction alone is the dry skeleton, and education is flabby and invertebrate without instruction. The teacher must therefore bear Froebel's fifth canon in mind, and teach his pupils not merely how to get a living, but also how to live. We trust from what we have said in this short summary that the student will see that there is a wide difference between teaching on Froebel's principles and the mere use of kindergarten games in school.

English Language and Literature.

Prepare a life of Addison, and pay particular attention to his relation to writers and other men of his period. Study the Sir Roger de Coverley Papers, and as the text itself is simple, make full notes on the characters.

Study in detail the third act of *Henry V.*, and make a note of any passage that throws light upon the characters.

English History.

Go carefully through the history from 1272 to 1399. Pay particular attention to social and constitutional questions. The *Confirmatio Chartarum* is important because it states that the king cannot levy money except "by the common consent of all the realm, and for the common profit thereof." This is the first law which placed the property of the subject under the direct control of Parliament, and made parliamentary sanction necessary for the raising of money.

Among other important laws passed under Edward the First were: The statute *De Donis*, which enabled the owners of land to settle their estates upon their descendants, so that the whole property should be in the hands of the senior male branch in perpetuity. Although objections may be raised to such a system nowadays, the plan was of very great influence in maintaining a powerful nobility, and so preventing such an accumulation of power in the hands of the sovereign as came to be the case in France. The power of the nobles was also increased by the statute *Quia Emptores*, which enacted that although a tenant might dispose of his rights, the old services and feudal claims of the chief should be unaffected by the transfer.

The *First Statute of Westminster* forbade any interference with the freedom of elections.

The *Statute of Mortmain* was intended to prevent the accumulation of landed property by the Church or other corporate bodies, and the statute *De Asportatione Religiosorum* prohibited the practice of raising money and sending it to the Pope or other persons beyond the sea.

The steps taken by Edward the First to administer the laws are as important as the laws themselves. The relations of England with the other parts of the British Isles are generally well known, as are also the wars with France. Sufficient attention is not as a rule paid to the social condition of the people and to the great men of the time. The cruelties practised on the Jews in England under Henry the Second, Richard, and John came to an end, it is true, in 1290, but that was by their banishment. All their property, claims, and mortgages were forfeited to the crown, and for four and a half centuries the Jews were a banished race from England.

The social state of the people is illustrated by the Statute of Winchester, passed in the thirteenth year of Edward the First's reign. This provided a sort of local police by making the inhabitants of each district liable to make compensation for crimes committed there, unless the criminals were brought to justice. It ordered that the gates of walled towns should be closed from sunset to sunrise, and any stranger attempting to pass should be arrested, and no one should be admitted as a lodger into the suburbs after nine o'clock, unless his host would be answerable. Another clause ordained that all highways leading from one market town to another should be cleared, so that no ill-disposed person could lurk in the bushes or ditches. If the owner of the land at the roadside would not clear it, he was to be responsible for all felonies committed there; and if murder were done, he was to be fined at the king's pleasure. The last clause required that every man should keep armour according to his station in life, so that he might be able to help in maintaining order and peace. In the reign of Edward the First trial by jury came to be thoroughly established as the course of legal procedure in all disputed cases. The Anglo-Saxon trials by jury were the foundation of this method; but in that case the jurors were men selected on account of their knowledge of the matter, and they practically *judged* the case. From the time of Edward the First up to the

present the function of the jury has been to hear the evidence and to decide on matters of fact. The judge then pronounces the way in which the law applies to the facts.

The quarrel between Edward the First and the Church is frequently overlooked. The English clergy were between two fires. The Pope and the king both looked upon the revenues of the Church as a source from which they ought to draw when they wanted money. In 1296, Pope Boniface issued a bull forbidding the clergy to pay to any layman out of their ecclesiastical revenues any tax or impost unless the Pope's consent had been previously obtained. Robert Winchelsea, the Archbishop of Canterbury, openly declared that he would disobey the king rather than the Pope. Edward adopted the principle that those who refused to support the Government forfeited all claim to be supported by the Government, and the Chief Justice of the King's Bench announced that the attorneys of clergymen would no longer be heard in the king's courts, but that claims *against* clergymen would be heard and enforced. The clergy instantly found their persons and property at the mercy of every spoiler. They soon gave way, and consented to pay the king's demand, and also a fine for their late insult to his authority.

In the reign of Edward the Third we have the first clear proofs of the exercise of the right of *impeachment* of king's officers. It was felt that the ordinary courts of justice were insufficient to punish very high offenders, and so the House of Lords was constituted the Court, and the commons acted as the accusers. In 1376, the year of the "Good Parliament," six of the king's officers were accused of various acts of ministerial misconduct. One of these fled from justice, but the other five were regularly tried before the House of Lords, convicted, and sentenced.

The internal or social history of England from the death of the Black Prince to the rebellion of Wat Tyler is of the highest importance. We see here the beginnings of the struggles between capital and labour, the origin also of our poor-law system, and the peculiar condition of the English peasantry with regard to the land. This may be regarded as the period during which the system of serfdom really broke up. Bondmen could obtain their liberty by residing a year in a chartered town. The frequent wars of the period led to the enfranchisement of many serfs; for the baron who had to provide a certain number of men was not very careful to inquire into such matters, and the villein who had served in the wars was not likely on his return to settle in a part of the country where he might be claimed as a bondman. The expense also of going to war or of making a figure in the tournament often led the barons to raise money by freeing their slaves. The clergy also taught that the liberation of serfs was an act of Christian charity.

In some cases the serf was made personally free, and received a grant of land from his lord on certain conditions, a *copy* of which was kept by the lord. In respect to every one else the serf became absolutely free; but if he did not keep the conditions set down in the "copy," his land reverted to the lord, although the man himself remained free. This is the origin of the "copyhold" system of tenure.

The residence in a town and service in the army were two ways in which a class of free labourers sprang up who were not connected with the land. These had no political standing, for they could hold no office, and had no vote in the elections. They might hope for relief from their neighbours in case of sickness, but they had no claim on the community. Thus there were many impotent poor for the legislators to deal with; there was a great increase of vagabondage and of mendicity. It was not till the fifth year of Elizabeth that the first statute was passed introducing compulsory taxation for the relief of the impotent poor, though several laws had directed the clergy to stir up the charitable in the cause of the necessitous. The problem of the "unemployed" never existed in mediæval times. Still it is clear that landowners and other employers previous to the Black Death never found a difficulty in securing labourers. This great pestilence is calculated to have carried off one half the population of England. This led to a smaller demand for land, with a consequent reduction in the rent; and the landed proprietors whose income was thus reduced were called upon by the labourers to pay higher wages, in consequence of the diminished supply of labour.

In connection with the Statute of Labourers, which was passed in 1349 to deal with this condition of affairs, the first question that arises is, "Is it right to pass such an Act at all?" We now generally hold that a man has the absolute right to try to dispose of his property or of his labour for whatever price he likes to ask. But although modern laws leave such things to settle themselves, yet if a landowner selfishly refuses to part with his land for a purpose which is for the public good—for example, a road—the law can compel him to sell it, and can fix the price. So if labourers were to combine to produce a famine, a Government is justified in meeting them by legislative action. The next question is, "Was this particular law just?" This we must answer in the negative. It was a one-sided piece of legislation. It fixed the rate at which labourers were bound to work, but did not require proprietors to give them work at that rate; and, secondly, by fixing the rate at that which had prevailed in the district before the Black Death, it took no account of the fact that, owing to a general rise in prices, money had not the same purchasing power as formerly. Such was the rise that the same amount of money could only procure one-fourth of the amount of food and other necessaries of life. The ordinance commanded that victuals should be sold at reasonable prices. Another clause ordered, under pain of imprisonment, that no one should give anything to a beggar who was able to work. When Parliament met in 1350, the Commons (who of course represented the employers and not the labourers) petitioned the king on the subject of the ordinance, not because it was unjust, but because it was not enforced with sufficient stringency. So in 1360 it was enacted that labourers who absented themselves from their work should have the letter F branded on their foreheads. Before the plague a labourer earned 1½d. or 2d. a day, and wheat cost 2d. per peck; later on wheat cost about 4½d. per peck, so that a whole day's wages would purchase barely half a peck of wheat.

In 1377 a poll-tax of fourpence a head was imposed. In 1379 a graduated tax was imposed, ranging from 4d. on a labourer to £6, 13s. 4d. on a duke. But the next Parliament, in 1380, imposed a uniform poll-tax of 4d., and this was the immediate cause of Tyler's insurrection.

Geography.

Finish the geography of Europe.

Arithmetic.

Study the chapters on decimals, paying particular attention to the theory. Many points in the chapter on theory of decimals are of great importance, not only as matters of theory, but as suggesting shortened methods of working in practice.

Algebra.

To the end of simple equations, with two or more unknowns.

Euclid.

Work deductions on the second book, and prepare the first fifteen propositions of the third book. As a matter of fact these may all be regarded as easy deductions on Book I. They require no explanation.

Elementary Science.

We have to consider next the "indestructibility of matter." The fundamental principle on this subject is that matter cannot be created and cannot be destroyed by any means that we have at our disposal. The student is often asked to *prove* this, but of course it is not a statement that admits of absolute proof. All we can do is to show by means of the balance or other instrument of accurate measurement that even in those cases in which matter disappears, and therefore seems to be destroyed, it merely takes up other forms and is still in existence. Among the cases that might be examined are:—

(*a*) The disappearance of a solid in solution. It can be shown, however, that the weight of the solution is just the sum of the weights of the solid and the solvent, and, moreover, the same weight of the solid may be recovered when the liquid evaporates.

(*b*) The disappearance of an evaporating liquid. By proper arrangements the vapour may be collected and condensed to its original condition.

(*c*) The disappearance of a burning body. This is generally illustrated in the text-books by the burning candle, with the arrangements for collecting the products of combustion. The details of this experiment should be mastered, and the diagram illustrating it should be practised until it can be drawn from memory.

Although we regard the "indestructibility of matter" as an axiom now, it was not accepted by our ancestors. In fact, it would never have been demonstrated had not the balance been brought into use in determining the quantities of substances. When a chemical substance combined with something else, it was too frequently assumed to have passed into another form; for instance, the caustic alkalis were supposed to be the same as the carbonates in composition, but to have taken up heat. The researches of Black, in which he used the balance, proved that the carbonate of soda is not a simpler body than the caustic soda, but a more complex one. Following on in the same lines, Lavoisier and Priestley made their great experiments with oxygen, and showed that combustion consisted of the union of the combustible substance with oxygen.

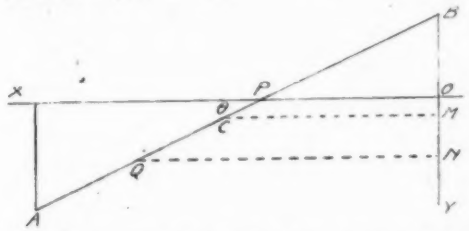
OUR QUERY COLUMN.

RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the name and address of the correspondent, and the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

Boz.—Trace the tension of a chain as a cylindrical wooden pile, rigidly floating in water, is hoisted slowly out of the water by a chain attached to one end, and prove that the other end of the pile describes a quadrant of an ellipse till the pile is vertical; and prove that the pile is vertical when the length out of water exceeds $\sqrt{1-s}$ times the length of the pile, s denoting the specific gravity of the wood.



Let AB represent the pile having a chain attached to the end B, and let the angle APX, which the length of the pile makes at any instant with the horizontal, be denoted by θ.

The pile when at rest is under the action of three forces—namely, its weight, acting at its middle point; the resultant fluid pressure, which is equal to the weight of the water displaced, and acts at the middle point of AP, the portion of the pile immersed; and thirdly, the tension of the chain. Since the directions of the two first of these are both vertical, the direction of the chain must also be vertical.

Taking moments about any point in the direction of the chain, we have for the distance from the direction of the chain of C, the middle point of AB, $\frac{l}{2}\cos\theta$, where l is the length of AB, and for the distance of Q, the middle point of AP, from the same line we have $\left(l-\frac{\lambda}{2}\right)\cos\theta$, where λ is the length of AP; therefore $ls\,.\,\frac{l}{2}\cos\theta = \lambda\,.\,\left(l-\frac{\lambda}{2}\right)\cos\theta$.

Hence, till the pile is vertical, we have $sl^2 = 2l\lambda - \lambda^2$.

Therefore $\lambda - l = \pm(\sqrt{1-s})l$; and, since l must always be greater than λ, we must take

$$l - \lambda = \sqrt{1-s}\,.\,l. \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

From this result it follows that until θ becomes equal to $\frac{\pi}{2}$, the length of AP, the portion immersed, is constant; therefore the resultant fluid pressure is constant. But the tension of the chain is equal to the difference between the weight of the pile and the resultant fluid pressure. Hence it follows that the tension of the chain is constant until the pile is vertical.

Again, taking O, the projection of the end B upon the surface of the water, as origin, and OX, the projection of BA upon the same plane, as axis of x, we have for the rectangular co-ordinates of the end A,

$$x = l\cos\theta,\ y = \lambda\sin\theta.$$

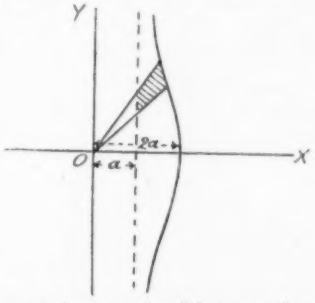
Hence $\frac{x^2}{l^2} + \frac{y^2}{\lambda^2} = \cos^2\theta + \sin^2\theta = 1$.

But we have seen that until the pile is vertical λ is constant and less than l; therefore the locus of A is an ellipse.

Again, from (1) we have $l - \lambda = \sqrt{1-s}\,.\,l$; that is, the length out of water is $\sqrt{1-s}$ times the length of the pile until the pile is vertical. Hence, when the length out of water exceeds $\sqrt{1-s}$ times the whole length, the pile must be vertical.

Spero.—Find the area between the curve $r = a(\sec\theta + \cos\theta)$ and its asymptote.

Edwards's *Integral Calculus*, p. 180, Example 30.



The element of area enclosed between the curve and two nearly coincident radii vectores is equal to

$$\tfrac{1}{2}r^2d\theta = \tfrac{1}{2}a^2(\sec^2\theta + 2 + \cos^2\theta)d\theta.$$

The area of that part of this element lying between the asymptote $x = a$ and the origin (Fig. 1) is equal to

$$\tfrac{1}{2}a\sec^2\theta d\theta.$$

Hence the element of area enclosed by the curve, the asymptote, and two nearly coincident radii vectores is equal to $\tfrac{1}{2}a^2(2+\cos^2\theta)d\theta$.

The total area enclosed between the curve and the asymptote is obviously equal to

$$2\times\frac{a^2}{2}\int_0^{\frac{\pi}{2}}(2+\cos^2\theta)d\theta$$

$$= a^2\left[2\theta + \frac{\cos\theta\sin\theta}{2} + \frac{\theta}{2}\right]_0^{\frac{\pi}{2}}$$

$$= \frac{5a^2\pi}{4}.$$

Cocker.—Kindly state exactly what you mean by "The New Geometry," and whether the syllabus of any particular examining body is referred to.

Bat.—**The angle between the asymptotes of a hyperbola is 2α; a straight line is drawn through a focus, making an angle θ with the major axis. Prove that the portion of it intercepted between the curve and the nearest asymptote is $\frac{a \sin\theta}{\sin\alpha + \sin\theta}$, where a is the semi-transverse axis.**

Let C be the centre, S a focus, and let a line SPQ, making an angle θ with CS produced, meet the curve in P and the nearest asymptote in Q.

Taking S as the origin, and the direction of CS as the axis of x, the equation referred to rectangular axes of the line CQ is $y = \tan\alpha \,.\, x + ae \tan\alpha$, for $CS = ae$, and therefore the intercept of CQ on the axis of y is $ae\tan\alpha$.

But the equation of SQ (referred to the same origin and axes) is $y = \tan\theta \,.\, x$.

Hence the x co-ordinate of the point Q is given by the equation $(\tan\theta - \tan\alpha)x - ae\tan\alpha = 0$. Therefore the x co-ordinate of the point Q is $x = \frac{ae\tan\alpha}{\tan\theta - \tan\alpha}$.

Hence the length of SQ is given by

$$SQ = \frac{ae\tan\alpha}{\tan\theta - \tan\alpha} \,.\, \sec\theta.$$

But in the hyperbola $e = \sec\alpha$. Therefore

$$SQ = \frac{a\sec\alpha\tan\alpha\sec\theta}{\tan\theta - \tan\alpha};$$

and this expression reduces to $a \,.\, \frac{\tan\alpha}{\sin(\theta - \alpha)}$.

Again, for the length of SP we have the well-known expression, $SP = \frac{l}{1 - e\cos\theta}$, where l is the length of the semi-latus rectum.

Now, in the hyperbola, $l = \frac{b^2}{a} = a \,.\, \frac{b^2}{a^2}$.

$$\therefore SP = \frac{a\tan^2\alpha}{1 - \sec\alpha\cos\theta} = a\sin\alpha \,.\, \frac{\sin\alpha}{\cos\alpha(\cos\alpha - \cos\theta)}.$$

But we have seen that $SQ = a\sin\alpha \,.\, \frac{1}{\cos\alpha\sin(\theta - \alpha)}$.

$$\therefore PQ = a\sin\alpha\left\{\frac{1}{\cos\alpha\sin(\theta - \alpha)} - \frac{\sin\alpha}{\cos\alpha(\cos\alpha - \cos\theta)}\right\}.$$

$$\therefore PQ = a\sin\alpha\sec\alpha\left\{\frac{\cos\alpha - \cos\theta - \sin\alpha\sin(\theta - \alpha)}{\sin(\theta - \alpha)(\cos\alpha - \cos\theta)}\right\}$$

$$= a\sin\alpha \,.\, \frac{2\sin\frac{\theta + \alpha}{2} \,.\, \sin\frac{\theta - \alpha}{2} - \sin\alpha \,.\, 2\sin\frac{\theta - \alpha}{2}\cos\frac{\theta - \alpha}{2}}{\cos\alpha \,.\, 2\sin\frac{\theta - \alpha}{2}\cos\frac{\theta - \alpha}{2} \,.\, 2\sin\frac{\theta + \alpha}{2}\sin\frac{\theta - \alpha}{2}}$$

$$= a\sin\alpha \,.\, \frac{\sin\frac{\theta + \alpha}{2} - \sin\alpha\cos\frac{\theta - \alpha}{2}}{\cos\alpha\left(2\sin\frac{\theta + \alpha}{2} \,.\, \cos\frac{\theta - \alpha}{2}\right)\sin\frac{\theta - \alpha}{2}}$$

$$= \frac{a\sin\alpha}{\sin\theta + \sin\alpha} \,.\, \frac{\sin\frac{\theta + \alpha}{2} - \sin\alpha\cos\frac{\theta - \alpha}{2}}{\cos\alpha \,.\, \sin\frac{\theta - \alpha}{2}}$$

$$= \frac{a\sin\alpha}{\sin\alpha + \sin\theta} \,.\, \frac{\sin\frac{\theta}{2}\cos\frac{\alpha}{2} + \cos\frac{\theta}{2}\sin\frac{\alpha}{2} - 2\sin\frac{\alpha}{2}\cos\frac{\alpha}{2}\left(\cos\frac{\theta}{2}\cos\frac{\alpha}{2} + \sin\frac{\theta}{2}\sin\frac{\alpha}{2}\right)}{\cos\alpha\sin\frac{\theta - \alpha}{2}}$$

$$= \frac{a\sin\alpha}{\sin\alpha + \sin\theta} \,.\, \frac{\sin\frac{\theta}{2}\cos\frac{\alpha}{2}\left(1 - 2\sin^2\frac{\alpha}{2}\right) + \cos\frac{\theta}{2}\sin\frac{\alpha}{2}\left(1 - 2\cos^2\frac{\alpha}{2}\right)}{\cos\alpha\sin\frac{\theta - \alpha}{2}}$$

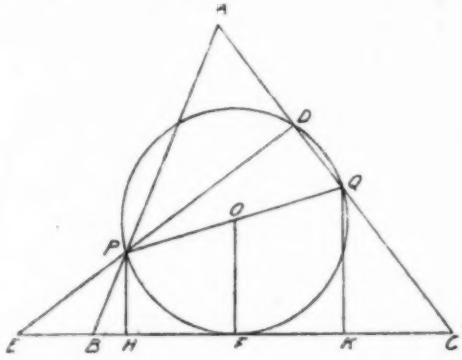
$$= \frac{a\sin\alpha}{\sin\alpha + \sin\theta} \,.\, \frac{\sin\frac{\theta}{2}\cos\frac{\alpha}{2}\left(\cos^2\frac{\alpha}{2} - \sin^2\frac{\alpha}{2}\right) - \cos\frac{\theta}{2}\sin\frac{\alpha}{2}\left(\cos^2\frac{\alpha}{2} - \sin^2\frac{\alpha}{2}\right)}{\cos\alpha\sin\frac{\theta - \alpha}{2}}$$

$$= \frac{a\sin\alpha}{\sin\alpha + \sin\theta} \,.\, \frac{\left(\sin\frac{\theta}{2}\cos\frac{\alpha}{2} - \cos\frac{\theta}{2}\sin\frac{\alpha}{2}\right)\left(\cos^2\frac{\alpha}{2} - \sin^2\frac{\alpha}{2}\right)}{\cos\alpha\sin\frac{\theta - \alpha}{2}}$$

$$= \frac{a\sin\alpha}{\sin\alpha + \sin\theta} \,.\, \frac{\sin\frac{\theta - \alpha}{2}\cos\alpha}{\cos\alpha\sin\frac{\theta - \alpha}{2}} = \frac{a\sin\alpha}{\sin\alpha + \sin\theta}. \quad Q.E.D.$$

S.R.—**We know of no book exactly covering this course, but if you have not yet used *Practical Organic Chemistry*, Chapman Jones (M'Dougall), or Rident's *Practical Organic Chemistry* (A. K. Smith, Gower Street), you might use them.**

Discan.—**P is a given point in the side AB of a triangle ABC. Show how to find a point Q in the side AC such that the distance PQ may equal the sum of the perpendiculars let fall from P and Q upon BC.**



Draw PD perpendicular to CA. Produce DP, CB to meet in E. Find F in EC such that $EF^2 = DE \,.\, EP$ (Euclid, II. 14). Through D, F, P describe the circle DFP, cutting CA again in Q. Then Q is the required point. Join PQ, and bisect this line in O. Then, since PDQ is a right angle, PQ is a diameter and O the centre of the circle PDF. From P and Q let fall the perpendiculars PH, QK upon BC. Join OF. Since $DE \,.\, EP = EF^2$, therefore EF is a tangent to the circle DFP. Hence OF is perpendicular to BC. Since O is the middle point of PQ, and PH, OF, QK are parallels, therefore OF is half the sum of PH and QK. But OF is half PQ, therefore PQ is equal to the sum of PH and QK.

Scotty.—**A, B, and C start on a journey, having £9, £7, 10s., and £5, 10s. respectively. At the end it is found that A has 10s., B £5, and C £1, 15s. For expenses common to B and C only, B has paid £1, 10s.; for private expenses A has paid £1, B 10s., and C £1. All other expenses are made to defray expenses in common. How should they divide the money which is over?**

Towards the expenses common to all three—
A has contributed £9 − (£1 + 10s.), or £7, 10s.
B ,, ,, £7, 10s. − (£1, 10s. + 10s. + £5), or 10s.
C ,, ,, £5, 10s. − (£1 + £1, 15s.), or £2, 15s.

Hence the expenses common to A, B, and C have amounted to £7, 10s. + 10s. + £2, 15s., or £10, 15s. Therefore each person's share of the common expenses is one-third of £10, 15s., or £3, 11s. 8d.

Hence B owes A £3, 11s. 8d. − 10s., or £3, 1s. 8d.; and C owes A £3, 11s. 8d. − £2, 15s., or 16s. 8d.

But C owes B 15s. Therefore C may pay to A 16s. 8d. + 15s., or £1, 11s. 8d., and B may pay to A £3, 1s. 8d. − 15s., or £2, 6s. 8d.

Ans. B pays to A £2, 6s. 8d.; C pays to A £1, 11s. 8d.

Fr. X.—**A dealer uses a false balance in which 9 lbs. apparently weigh 10 lbs., constantly to his own advantage. He buys goods by his own scales at 3s. 4d. per lb., and sells at 3s. 6d. per lb. Find his profit per cent.**

For 10 lbs. of goods he pays 9 × 3s. 4d., or 30s.

For 10 lbs. of goods he obtains $10 \times \frac{10}{9} \times$ 3s. 6d., or $\frac{350}{9}$s.

Therefore on an outlay of $\frac{270}{9}$s. he gains $\frac{350 - 270}{9}$s., or $\frac{80}{9}$s.

Therefore on an outlay of 270s. he gains 80s.

Therefore on an outlay of 100s. he gains $\frac{8000}{270}$s.

His gain is therefore $\frac{800}{27}$ per cent. of his outlay.

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E. C. Park.—Find the number of words that can be made of $n + 2$ letters, taken 5 together, if n letters are alike and of one kind, and the other two are different and unlike, when n is greater than 5.

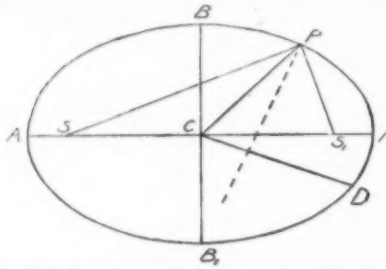
Suppose we have n a's, one b, and one c. Then we can have one word containing a's only. Of words containing four a's and one b we can have $\frac{|5}{|4\,|1} = 5$.

Similarly, of words containing four a's and one c we can have 5.

Of words containing three a's, one b, and one c we can have $\frac{|5}{|3\,|1\,|1} = 20$.

Hence altogether we can have $1 + 5 + 5 + 20 = 31$ words.

Esk.—A bead is strung on a thread whose two extremities are fixed, and on which it can move without friction. Show that if the bead is started so as to move in the elliptic arc to which it is constrained its velocity will be uniform. Show also that the tension of the thread for different positions of the bead varies inversely as the product of the two focal radii vectors.



Let S, S_1 be the fixed ends of the thread, and therefore the foci of the ellipse of constraint APA_1. Then, as shown in any standard work on dynamics of a particle, the pressure on the constraining curve at any point P is given by $\frac{v^2}{\rho}$, where v is the velocity along the curve, and ρ the radius of curvature at the point P. The velocity v must necessarily be uniform, since in the absence of friction the pressure on the bead must always be normal to the curve, and therefore there is no impressed force along the curve. Now in an ellipse the focal radii vectors PS, PS_1 make equal angles with the normal at P. Denoting each of these angles by α, and the tension of the thread by T, we have

$$2T \cos \alpha = \frac{v^2}{\rho}. \quad \text{Therefore } T \propto \frac{1}{\rho \cos \alpha}.$$

Denoting the semi-diameter CP by b', and the conjugate semi-diameter CD by a', the radius of curvature at P is given by $\rho = \frac{a'^2}{ab}$.

Again, denoting SP by r_1 and S_1P by r_2, we have, by a well-known property of the ellipse, $r_1 r_2 = a'^2$. (See Loney's *Co-ordinate Geometry*, § 287.)

We have already denoted the angle SPS_1 by 2α. Denoting as usual the length SS_1 by $2c$, we have, from the triangle SPS_1,

$$\cos \alpha = \sqrt{\frac{\frac{r_1 + r_2 + 2c}{2} \cdot \frac{r_1 + r_2 - 2c}{2}}{r_1 \cdot r_2}}.$$

But the sum of the focal radii vectors of an ellipse is equal to the axis major, therefore

$$\cos \alpha = \sqrt{\frac{(a + c)(a - c)}{r_1 r_2}} = \sqrt{\frac{a^2 - c^2}{r_1 r_1}} = \frac{b}{\sqrt{r_1 r_2}}.$$

But $\sqrt{r_1 r_2} = a'$. $\therefore \cos \alpha = \frac{b}{a'}$.

Hence $\rho \cdot \cos \alpha = \frac{a'^2}{ab} \cdot \frac{b}{a'} = \frac{a'^2}{a} = \frac{r_1 r_2}{a}$.

But we have shown that

$$T \propto \frac{1}{\rho \cos \alpha}; \text{ hence } T \propto \frac{1}{r_1 r_2}.$$

That is, for any position P of the bead, the tension of the thread varies inversely as the product of the two focal radii vectores. *Q.E.D.*

Genistus.—Find the condition that one of the lines

$$ax^2 + 2hxy + by^2 = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

may be perpendicular to one of the lines

$$a'x^2 + 2h'xy + b'y^2 = 0. \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Let the line

$$y - mx = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

be one of the lines of (1). Then the line

$$my + x = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

is a line passing through the origin and perpendicular to the line (3).

We have, therefore, to find the condition that while (3) is a line of (1), (4) shall be a line of (2).

Since (3) is one of the lines of (1), then (1) must be satisfied by the value $\frac{y}{x} = m$. Therefore

$$a + 2hm + bm^2 = 0. \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Again, if (4) is one of the lines of (2), then (2) must be satisfied by the value $\frac{x}{y} = -m$. Therefore

$$a'm^2 - 2h'm + b' = 0. \quad . \quad . \quad . \quad . \quad . \quad (6)$$

The required condition is obtained by eliminating m between equations (5) and (6).

From (5) we have

$$ab' + 2hb'm + bb'm^2 = 0, \quad . \quad . \quad . \quad . \quad (7)$$

and from (6) we have

$$ab' - 2h'am + aa'm^2 = 0. \quad . \quad . \quad . \quad . \quad (8)$$

Subtracting (7) from (8), we have

$$(aa' - bb')m^2 - 2(h'a + hb')m = 0.$$

$$\therefore \frac{m^2}{2(h'a + hb')} = \frac{m}{aa' - bb'}. \quad . \quad . \quad . \quad . \quad (9)$$

Again, from (5) we have

$$a'bm^2 + 2ha'm + aa' = 0, \quad . \quad . \quad . \quad . \quad (10)$$

and from (6) we have

$$a'bm^2 - 2h'bm + bb' = 0. \quad . \quad . \quad . \quad . \quad (11)$$

Hence, on subtracting (11) from (10), we have

$$2(ha' + h'b)m + aa' - bb' = 0.$$

$$\therefore \frac{m}{aa' - bb'} = \frac{-1}{2(ha' + h'b)}. \quad . \quad . \quad . \quad . \quad (12)$$

Then, from (9) and (12), we have

$$\frac{m^2}{2(h'a + hb')} = \frac{m}{aa' - bb'} = \frac{-1}{2(ha' + h'b)}.$$

$$\therefore -\frac{h'a + hb'}{ha' + h'b} = m^2 = \frac{(aa' - bb')^2}{4(ha' + h'b)^2}.$$

$$\therefore (aa' - bb')^2 + 4(ha' + h'b)(h'a + hb') = 0.$$

And this is the condition that one of the lines

$$ax^2 + 2hxy + by^2 = 0$$

may be perpendicular to one of the lines

$$a'x^2 + 2h'xy + b'y^2 = 0.$$

Arum.—Obtain an expansion of $\log_e x$ in ascending powers of $\frac{x - 1}{x + 1}$.

Since $x = \left(1 - \frac{1}{x + 1}\right) \div \left(1 - \frac{x}{x + 1}\right)$,

$$\therefore \log_e x = -\log_e \left(1 - \frac{x}{x + 1}\right) + \log_e \left(1 - \frac{1}{x + 1}\right).$$

$$\text{Hence } \log_e x = \left\{\frac{x}{x + 1} + \tfrac{1}{2}\frac{x^2}{(x + 1)^2} + \tfrac{1}{3}\frac{x^3}{(x + 1)^3} + \dots\right\} - \left\{\frac{1}{x + 1} + \tfrac{1}{2}\frac{1}{(x + 1)^2} + \tfrac{1}{3}\frac{1}{(x + 1)^3} + \dots\right\}$$

$$= \frac{x - 1}{x + 1} + \tfrac{1}{2}\frac{x^2 - 1}{(x + 1)^2} + \tfrac{1}{3}\frac{x^3 - 1}{(x + 1)^3} + \dots$$

But $\log_a x = M \log_e x$, where M is the logarithm of e to the base a.

$$\therefore \log_a x = M\left\{\frac{x - 1}{x + 1} + \tfrac{1}{2}\frac{x^2 - 1}{(x + 1)^2} + \tfrac{1}{3}\frac{x^3 - 1}{(x + 1)^3} + \dots\right\}.$$

S.N.W.—A bill falls due in six months. The creditor agrees to accept immediate payment of one-half, and to defer the payment of the other half for one year. He finds that by this arrangement, reckoning interest at 6 per cent. per annum, he gains nine shillings. What is the amount of the bill?

The interest on £1 for six months at 6 per cent. per annum = £$\frac{3}{100}$.

The present worth of £1 due in six months at 6 per cent. per annum = £$\frac{100}{103}$.

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Hence, by the arrangement adopted, the creditor gains $£_{1}\frac{2}{3}$, but loses $£(1 - \frac{2}{3}\frac{2}{3})$, or $£_{1}\frac{2}{3}$, on a bill for £2.

The net gain to the creditor by this arrangement is therefore $£(_{1}\frac{2}{3} - _{1}\frac{2}{3})$, or $£_{10}\frac{2}{30}$, on each £2 in the bill.

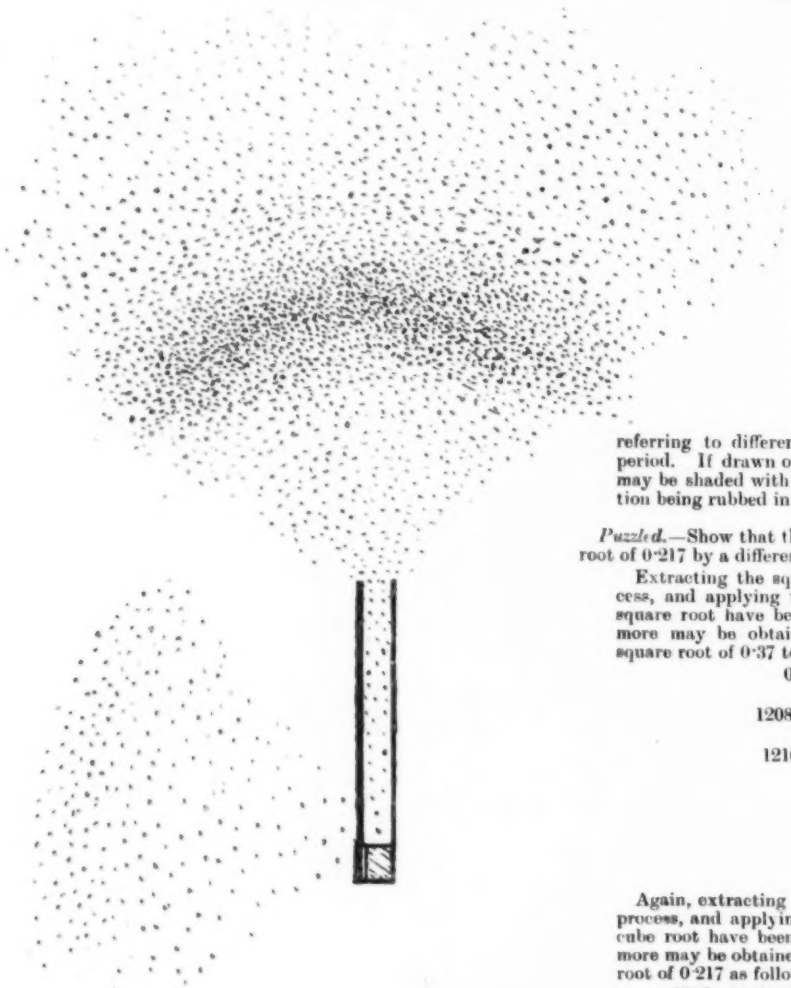
Since a gain of $£_{10}\frac{2}{30}$ requires a bill for £2, therefore a gain of £1 requires a bill for $£^{10}\frac{0}{2}{}^{0} \times 2$, and therefore a gain of £0·45 requires a bill for $£^{10}\frac{0}{2}{}^{0} \times 2 \times \cdot 45$.

But $£^{10}\frac{0}{2}{}^{0} \times 2 \times \cdot 45 = £1030$.

The amount of the bill is therefore £1030.

Pupil.—Describe (*a*) the motion of the air in an organ-pipe that is sounding its fundamental tone; (*b*) that of the air outside the pipe by which the sound is transmitted. Also explain (best with the help of a diagram) the connection between the motion of the air inside and outside the pipe.

(Inter. Science, London, 1885.)



The diagram represents, at a particular moment, the condition of the air within an open organ-pipe, and that of the external air in the immediate neighbourhood of the pipe. At the open end of the pipe the air particles oscillate backward and forward. At the instant considered these particles have reached their maximum distance of displacement from left to right. At the mouth of the pipe the density of the air is always approximately that of the undisturbed surrounding air. Within the pipe the air particles have been moving from left to right, and consequently, at the closed end, the air has reached its condition of maximum rarefaction. Outside the pipe, in the neighbourhood of the mouth, the air particles have also been moving from left to right. At a distance from the mouth approximately equal to the length of the pipe, the air has reached its condition of maximum density. Farther away still the density diminishes, and at a distance from the mouth approximately equal to twice the length of the pipe, the density of the air is normal. Here the air particles have been moving from right to left, and have just reached their condition of maximum displacement. Spherical sound waves also radiate from the embouchure of the pipe. At the instant to which the diagram refers there is a rarefaction in the immediate neighbourhood of the embouchure, while the density of the air increases as we proceed farther away from it, and reaches its normal value at a distance approximately equal to the length of the pipe.

As time proceeds, the air particles move back into the pipe. After a quarter of the period of vibration of the air column, the air throughout the pipe has reached its normal density. After another quarter period, an excess of air particles has entered the pipe, and the air at the closed end has reached its condition of maximum condensation. During this time the wave front, which originally was in a state of maximum condensation, has spread out toward the right, having travelled through a distance equal to half a wave-length. Thus, at the moment we are considering, there will be a region of maximum rarefaction at a distance from the mouth equal to the length of the pipe. In other words, we should now draw a diagram similar to that here given, but altered so that regions of maximum condensation are changed for those of maximum rarefaction, while regions of maximum rarefaction are changed for those of maximum condensation. The student should find no difficulty in drawing a number of similar diagrams, but referring to different times during a complete vibration period. If drawn on brown paper, regions of condensation may be shaded with pencil or black chalk, those of rarefaction being rubbed in with white chalk.

Puzzled.—Show that the square root of 0·37 exceeds the cube root of 0·217 by a difference which very nearly equals $_{1}\frac{1}{3}\frac{1}{6}$.

Extracting the square root of 0·37 by the ordinary process, and applying the rule that when $n + 1$ figures of a square root have been obtained by the ordinary method, n more may be obtained by division only, we obtain the square root of 0·37 to six places of decimals as follows:—

```
0·37̇00̇00̇00̇(0·608276
  36
1208) 10000
       9664
12162) 33600
       24324
         9276
        85134
         7626
        72972
         3288
```

Again, extracting the cube root of 0·217 by the ordinary process, and applying the rule that when $n + 2$ figures of a cube root have been obtained by the ordinary method, n more may be obtained by division only, we obtain the cube root of 0·217 as follows:—

```
 1809   108000000   0·217̇000̇000̇000̇(0·600926
    9       16281     216000000
         108016281    1000000000
                       972146529
                        27853471
                       216032562
                        62502148
```

Therefore the difference between the square root of 0·37 and the cube root of 0·217 is 0·608276 − 0·600926, or 0·00735, correct to five places of decimals.

Now $\frac{1}{136} = \frac{0{\cdot}125}{17} = 0{\cdot}007353$ (nearly).

Hence the square root of 0·37 exceeds the cube root of 0·217 by a difference which very nearly equals $_{1}\frac{1}{3}\frac{1}{6}$.

(*Continued on page 211.*)

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(ADVANCED AND HONOURS.)

The Earth's Axis.—About five years ago the International Geodetic Association, whose headquarters are at Potsdam, determined that very careful observations should be made to settle the question whether the axis about which our globe rotates is really fixed, or whether it does actually shift during the year, as appeared from the discussion of previous observations. For this purpose six small observatories were set up in very nearly the same latitude (namely, 39° 8′ N.), but in different parts of the world—in Japan, in Russian Asia, in an island near Sardinia, three in the United States, one being in California; and at these places accurate measurements of the latitude have been made since the autumn of 1899. It is obvious that if the equator is not fixed, but rocks a little at times when the latitude in Russia is found to be greater than the normal in California, which is nearly diametrically opposite, the distance from the imaginary line would necessarily have a comparatively small value, and similarly for other places. The first instalment of results of the observations mentioned, which has recently been published, supplies very conclusive evidence of this kind, and leaves little doubt that in the years 1900 and 1901 the poles of the earth moved in spiral curves about their mean position, the radius increasing to nearly ten feet. The range of motion differs in different years, but is probably never excessively large. No mechanical reason can be assigned for this phenomenon, but the fact of its existence shows that our earth as a whole is at least as rigid as steel.

Radiation Pressure and Cometary Theory.—In No. 5, vol. xvii., of the *Astrophysical Journal*, Messrs. E. F. Nicholls and G. F. Hull describe and illustrate some laboratory experiments they have made at Dartmouth College, Hanover, U.S.A., in order to demonstrate the effect of the solar radiation pressure in the formation of comets' tails.

A glass tube shaped like an hour-glass was partially filled with sand and dried lycopodium powder, and then highly evacuated. On causing the sand and powder to fall from the upper to the lower part of the tube, and directing an intense beam of light against the stream, it was seen that, whilst the sand fell vertically, the powder was diverted in the direction of the beam, against the side of the tube opposite to the light source. Unfortunately, the light-pressure, on particles of the size and density used, had been previously overestimated, and a subsequent calculation showed that the observed deviation may not have been wholly due to the light-pressure, although some of it was.

Another suggestion as to the cause of repulsion in cometary phenomena is that the particles heated from one side evolve gases, and are, therefore, driven in the opposite direction in a similar manner to the ordinary rocket, and in the experiments performed by Messrs. Nicholls and Hull this "reaction" pressure would be about ten times as great as the "radiation" pressure. This research has experimentally illustrated the repulsion, and has shown that a part of it at least is probably due to the "radiation" pressure; it now remains to determine more definitely the relative effect of each of the possible causes.

The Canals on Mars.—In the fifth report of "The Section for the Observation of Mars" (British Astronomical Association *Memoirs*, vol. xi.), several charts of the planet's surface are reproduced, in one of which, Plate VIII., the director of the section, M. E. M. Antoniadi, has omitted the reticulated canal systems so familiar to aërographers on the charts published during the last twenty-five years. These have been omitted because recent research has thrown grave doubts on their objective reality.

In the recent experiments carried out by Messrs. Maunder and Lane, it was demonstrated that the regular "canaliform" markings may be consistently seen by numerous unbiased individuals on a surface which is free from any such markings, but which has drawn on it features similar to the other markings on Mars. It was also pointed out that, in general, the so-called canals on aërographical maps are drawn either from one projecting feature to another or where half-tone boundaries are seen on the planet, just where one would expect them to be drawn if they were really due to physiological suggestion.

Many so-called "canals" are retained on M. Antoniadi's chart, but these are not of the rigidly geometrical shape shown on the charts published during recent years, and are probably objective features of the Martian landscape (*Observatory*, No. 335).

The Temperature of Fixed Stars.—Some interesting results as to the temperature of a number of the fixed stars have been obtained by Mr. Harkanyi, who has made use of Vogel's measurements of stellar spectra. The method adopted is based on the fact that, as a body is heated, the most energetic portion of its spectrum gradually travels towards the violet end, in accordance with Wien's law, according to which $\lambda T = \text{constant}$; where λ denotes the wave-length of maximum energy and T the absolute temperature of the radiating body. The constant differs, however, with the character of the surface of emission, being 2·940 for absolutely black bodies and 2·630 for polished platinum. There is thus some doubt as to the truth of the absolute figures obtained; but the method, at any rate, permits of an accurate comparison as to the relative temperature of stars *inter se*. The sun, it appears, has a temperature intermediate between the highest and lowest figures noted, some being much hotter than it and others colder. Arcturus and Aldebaran, in spite of their splendour, are relatively cold, their temperatures being little above 2,000° C.

Penetrative Solar Radiations.—In a paper communicated to No. 24 of the *Comptes rendus*, M. R. Blondlot describes some simple experiments he has performed, which appear to show that certain rays (which he calls "the *n* rays") emitted by the sun are capable of passing through various kinds of wood, metals, etc. He placed a fine glass tube containing a phosphorescent material—for example, sulphide of calcium—in a darkened room in which there was a window exposed to the sun, but closed by means of an oaken shutter 15 mm. thick, and then found that the phosphorescent material, which he had previously exposed for a short time to feeble sunlight, continued to glow; but if a plate of lead were interposed between the shutter and the tube, the phosphorescence became feebler, whilst it again increased when the lead was removed. Then an oaken joist 3 cm. thick, a piece of cardboard, and several plates of aluminium were successively interposed, and the phosphorescence emitted did *not* diminish, but a thin layer of pure water entirely arrested the *n* radiations. These radiations may be concentrated by a quartz lens, but are regularly reflected by a polished glass surface, whilst an unpolished glass surface diffuses them.

Sun Spots and Rainfall.—The recent heavy rainfall, inconvenient as it has been to the world at large, has, however, given satisfaction to some of the weather observers at South Kensington. In the Solar Physics Observatory is a chart drawn up by Dr. W. S. Lockyer, showing the increase or decrease of sun-spot area; in connection with it, other curves show the rainfall in different areas and countries. It is attempted by means of these curves to demonstrate some relation between sun spots and rainfall—an attempt which has been so far unsuccessful; but this year these rain-curves are all going up with the approach to the thirty-five year sun-spot maximum. The heavy rainfall has, at any rate, purified the air of London, probably by oxidising it, but certainly by washing down solid particles. Some rain-water that was collected in the Strand between June 13 and 15 was found to contain more than nine grains of solid matter per

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gallon. There were traces of salt, ammonium sulphate, organic ammonia, and nitrates; though the chief constituents were soot and similarly suspended matter.

Thunderstorms and the Moon's Age.—Evidence of a connection between the occurrence of thunderstorms and the moon's age has been referred to in *Nature* on several occasions. Professor W. H. Pickering gives a table in *Popular Astronomy* to show the results of investigations of this relationship by various observers. From this table, which is abridged below, it will be seen that, with one exception, the number of thunderstorms occurring near the first two phases of the moon is greater than the number occurring near the last two.

The Moon's Phases and Thunderstorms.

Station.	Authority.	Years.	New and First Quarter.	Full and Last Quarter.
Kremsmünster	Wagner	86	54	46
Aix la Chapelle	Polis	60	54	46
Batavia, Java ...	Van d. Stok ...	9	52	48
Gotha	Lendicke	9	73	27
Germany ...	Köppen	5	56	44
Glatz County ...	Richter	8	62	38
N. America ...	Hazen	1	57	43
Prague	Gruss	20	51	49
,, ...	,, ...	20	53	47
Gottingen ...	Meyer	24	54	46
Greenwich ...	MacDowall ...	13	54	46
Madrid	Ventatasta ...	20	52	48
Providence, R.I.	Seagrave	6	49	51

Professor Pickering adds:—"The number of observations here collected seems to be large enough to enable us to draw definite conclusions, without fear that further records will revise or neutralise them. From these observations we conclude that there really is a greater number of thunderstorms during the first half of the lunar month than during the last half, also that the liability to storms is greatest between new moon and the first quarter, and least between full moon and last quarter. Also we may add that while theoretically very interesting, the difference is not large enough to be of any practical consequence. Thus it would seem that, besides the tides and certain magnetic disturbances, there is a third influence that we must in future attribute to the moon."—*Nature.*

CHEMISTRY.

(ADVANCED AND HONOURS.)

BY T. CARTWRIGHT, B.A., B.SC.

Liquid Air.—In Berlin liquid air is now being delivered to customers at the rate of two litres, roughly half a gallon, for about 1s. 6d. According to the *Energie*, published in that city, the receptacles are made of glass with double walls, the intermediate space between the walls being filled with non-conducting material, and the external surface silvered to prevent radiation. One of the most fortunate circumstances which the researches of Dewar and others have brought out is that glass will endure such remarkable differences of temperature between the liquid air within and the common air without, amounting to several hundreds of degrees, and yet suffer so little from brittleness. Several minor industries are carried on in which liquid air at 1s. to 2s. a gallon would be an economic commodity.

The Transmutation of Elements.—The transformation of one "element" into another, the realisation of the alchemists' dream of the "philosopher's stone," will probably soon be observed in radium. Sir William and Lady Huggins have sent to the Royal Society a paper which demonstrates that helium, the impalpable gas, so light that the mere rotation of the earth had whisked nearly all of it off into space millions of years before man's advent, is actually developed by the breaking down of the atoms of radium, which is probably the heaviest, as it is the scarcest, substance in the universe. We talk of atoms "breaking down" as if it were a commonplace, but only twelve months ago this revolutionary conception would have been meaningless nonsense. The president of the Royal Society and his learned wife have photographed the spectrum of the light given off by radium, and find that it is almost coincident with the spectrum of helium. Radium shines, therefore, by the light of this rare gas which it evolves, not by its own light.

Radium.—In a letter to the *Times*, Mr. W. C. D. Whetham, F.R.S., says:—"The 'rays' emitted by radium are of three kinds, all of which affect photographic plates, and render air through which they pass a conductor of electricity. The nature of the third kind is still under discussion, but there is overwhelming evidence to show that the first and second kinds consist of particles, charged with electricity, which are projected with enormous velocities. The particles in the first, or less penetrating rays, have masses of the same order as those of the light chemical elements such as hydrogen or helium; while the penetrating rays are composed of negatively-charged particles with masses about a thousand times smaller, which seem to correspond to the sub-atomic corpuscles already recognised by Professor J. J. Thompson in electric discharges through vacuum tubes. Such manifestations as these are quite unknown as the accompaniment of any chemical change, and seem to point to some process of an entirely different nature. Radio-activity appears to be a characteristic property of the element (radium, thorium, or uranium), and to be independent of the state of chemical combination in which that element exists. The activity of a given quantity of radium is the same whether it is combined as radium chloride or radium bromide; while uranium, the metal, has the same proportional activity as when chemically combined in uranium nitrated. On the view that radio-active properties are due to the decomposition of a compound of helium, we should expect the rate of decomposition to depend on the nature of any more complex chemical substance of which that compound might form part. Again, we should expect the rate of dissociation of a chemical compound to depend on the temperature, and probably to increase as the temperature rises; but we know that the activity of radium is the same in liquid air as at ordinary temperatures, while present evidence apparently indicates that it is increased by the exposure of the substance to the extreme cold of liquid hydrogen. The energy which would be radiated by the total exhaustion of one gramme of radium can be estimated from the known kinetic energy of the projected particles, and apparently is from twenty thousand to a million times as great as the energy liberated by the combination of hydrogen and oxygen when forming one gramme of water. Such evidence indicates that in radio-active change the store of internal energy of the atoms themselves is brought into play. The occurrence of helium in all radio-active minerals, the calculated mass of the less penetrating projecting particles, and the detection by Sir William Ramsay and Mr. Soddy of helium in the gases evolved on the solution in water of a salt of radium, all point to helium as one of the products of this atomic disintegration. The transmutation hypothesis is not conclusively proved; such a statement could be made with regard to few, if any, of our scientific theories. But it is not so entirely unexpected as might be supposed by those who have not followed recent physical investigations."

Action of Arsenic on Copper (Albert Granger).—Copper combines easily with arsenic when heated in a current of arsenic vapour mixed with an inert gas. A white mass is obtained, which is very brittle and of metallic appearance, and fuses at a red heat. At a temperature of 440° the arsenide of copper, Cu_2As_2, is formed; at a lower temperature, the lower arsenide, Cu_3As.

The Atomic Weight of Bismuth.—The discrepancies between the atomic weight of bismuth as determined by Schneider and Marignac = 208, and by Classen = 208·9, have been hitherto discussed on the assumption that the cause is the presence of lead. Mr. R. H. Adie, by adopting a combination of fractionation as subnitrate and distillation as chloride, has succeeded in obtaining sufficient silica from pure bismuth to account for the low values of the former observers. The determination of the atomic weight and the isolation of a new coloured substance is now proceeding.

Some Physical and Chemical Properties of Strong Nitric Acid.—It is shown that the density, contraction, refractive index, and electrical conductivity of strong nitric acid vary regularly until the concentration of the acid reaches 92 per cent., but from this point to 100 per cent. the variation is exceptional. These facts are in harmony with Hartley's view that acid of 96 per cent. strength contains a definite compound of the formula $3H_2N_2O_6,H_2NO_4$.

The Spectra of Neon, Krypton, and Xenon.—The gases were illuminated by the passage of the discharge from an induction coil through them under reduced pressures. Vacuum tubes were filled with each one of them, and the glowing gas in a capillary portion was examined "end on" through a quartz window. Considerable difficulty was experienced in the use of the tubes, owing to the disintegration of the electrodes and the

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absorption of the gas when the current was kept passing for long periods. The measurements were all made upon photographs taken with a Roland concave grating of 10 feet focus and 14,438 lines to the inch; the first three orders of spectra were employed, and nearly all the chief lines were measured in two orders. The probable error of the measurements is less than 0·03 Angström unit. Each gas gives bright-line spectra, krypton and xenon having two and neon one; the second spectra of krypton and xenon are produced by placing a Leyden jar and a spark gap in the circuit with the vacuum tube.

The Slow Oxidation of Methane at Low Temperatures (W. A. Bone and R. V. Wheeler).—The authors describe an apparatus for the closer investigation of slow-combustion processes. This is essentially a closed system in which the reacting gaseous mixture can be circulated day and night continuously, at a uniform rate (1) over a heated surface the temperature of which is kept constant, and (2) through suitable washing and cooling vessels for the removal of soluble or condensable intermediate products. A specially devised manometer allows of pressure records being taken at regular intervals, so that the velocity of the oxidation may be measured.

Further experiments with this apparatus on the interaction of methane (2 volumes) and oxygen (1 volume) at 450° and 500°, whilst they entirely confirm the authors' previous conclusion that neither hydrogen nor carbon is liberated at any stage of the oxidation, and that the final products consist simply of carbon monoxide, carbon dioxide, and steam, have proved the transient formation of formaldehyde as an intermediate product. In one experiment 13 per cent., and in another as much as 22 per cent., of the methane burnt was obtained as formaldehyde which had been rapidly removed from the sphere of action by passing the reacting mixture through cold water each time it left the tube containing the heated surface.

The authors conclude that the oxidation of methane involves the following stages:—

1. The simultaneous formation of formaldehyde and steam, by the bimolecular reaction, $CH_4 + O_2 = CH_2O + H_2O$.

2. The further oxidation of this formaldehyde to carbon monoxide, carbon dioxide, and steam. This is probably effected as the result of the simultaneous occurrence of the following reactions:—

(*a*) The bimolecular reaction, $CH_2O + O_2 = CO_2 + H_2O$.
(*b*) The trimolecular reaction, $2CH_2O + O_2 = 2CO + H_2O$.

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THE following series of "Notes" are intended for those who propose to take the Examinations in Theoretical Mechanics of the Board of Education, or the Mechanics Sections of the Intermediate Examinations of London University. The syllabus of the former is somewhat similar to that of the latter. An attempt will be made to give as much help as possible to those readers who are interested in the examinations referred to, but the space available in these columns will only permit those portions to be taken which are in many cases either ignored in text-books, or are so briefly expressed that the average student fails to thoroughly grasp the exact meaning of the symbols which are involved in a given formula or rule, the result being that usually he is quite unable to obtain an answer to even a fairly easy numerical question.

It may be pointed out at the outset that too much stress cannot be laid upon numerical work. There is probably no better test available for the greater number of students than that of good and well-selected numerical exercises; in fact, the principles of such a subject as mechanics are frequently only readily grasped when they are applied to definite and concrete arithmetical problems. In this manner clearer and more definite information is obtained than by any amount of mere reading. In such work it is, of course, unnecessary to use troublesome and tedious arithmetical processes. All such calculations may be easily made by using either a table of four-figure logarithms or a slide rule.

Syllabus and Text-Books.—It is perhaps unnecessary to point out that the syllabus in Theoretical Mechanics already referred to can be easily obtained from the secretary, Board of Education, and in like manner the syllabus dealing with the Intermediate Examination may be obtained by application at the London University.

With regard to a suitable book or books, it is impossible to suggest any that will meet all requirements. The best course will probably be to supplement the information which will be given from time to time in these "Notes" by reference to one or other of the books mentioned in the following list. It will also be of great benefit to carefully notice the queries and solutions in the Query Column of the *Practical Teacher*.

It is almost impossible to overestimate the importance of mathematics in such a subject as mechanics. If, however, the reader is familiar with elementary processes in arithmetic, algebra, and trigonometry, then no difficulty will be experienced, especially if, in addition, he is able to use the simple notions of the calculus. The choice of suitable books would necessarily depend on the mathematical abilities of a student. In the following list the more elementary works are placed first:—*The Student's Dynamics*, Minchin (G. Bell and Sons); *Elementary Statics*, Dobbs (A. and C. Black); *Hydrostatics and Pneumatics*, Pinkerton (Blackie and Son); *Elementary Hydrostatics*, Besant (Deighton, Bell, and Co.); *Elementary Dynamics*, Loney (Clay and Sons); *Statics*, Part I., Minchin (Clarendon Press); *Elementary Hydrostatics and Kinetics*, Minchin (Clarendon Press). More advanced works, such as Routh's *Statics and Dynamics* and Greenhill's *Hydrostatics*, may be consulted with advantage.

Units.—It is important that clear notions should be obtained of the three fundamental units *space*, *time*, and *mass*. The unit of space is usually either a *foot* or a *centimetre*; the unit of *time* one *second*; the unit of *mass* either the *pound* or the *gramme*.

Definitions.—Some care is necessary to avoid acquiring incorrect ideas relating to the various definitions. Thus a *particle* is usually defined as a material point in which the dimensions are indefinitely small in all directions. Such a definition, although accurate in a certain sense, may also be misleading. Thus, for example, a student not infrequently finds that the data of a problem specify that the weight of a particle is 100 lbs. This will obviously not agree with the preceding definition. In fact, it is sometimes necessary to consider the earth itself as a mere particle, moving in space in a vast curve round the sun as a centre. It is better to bear in mind that usually when the word particle is used only one motion of the body is considered. Thus, for example—A particle of mass 100 lbs. moves in a circular path of 3 feet radius, with a velocity of 50 feet per second. What forces are acting on the body? This simply means that only the motion in the circular path has to be considered; any motion which the body may have about its own axis is not taken into account.

Rigid Body.—This is another definition to which reference may be made. The usual definition is that a rigid body may be assumed to be composed of a number of particles, which are inseparably connected, and under all circumstances retain the same positions with regard to one another. It is obvious that this is simply an ideal conception. All bodies with which we are familiar may be made to alter their shapes and sizes. Hence it is better to define a rigid body as one not necessarily unchanged in size or shape, but one in which no changes occur during the interval of time considered.

Velocity.—The rate of change of position of a moving body is called its *speed*, or usually its *velocity*. The two terms are not necessarily the same. Velocity is a *vector*, and therefore implies both direction and magnitude. As the word *velocity* is in general use, it seems to be advisable to retain it in the following "Notes."

Rate.—The meaning attached to the word *rate* is of great importance. Thus rate of change of position is *velocity*. Similarly *rate of change of velocity is acceleration*. Acceleration may tend to increase or to diminish the velocity of a moving body. In the latter case it is referred to as negative acceleration, or *retardation*.

Uniform Velocity.—A body is said to move with uniform velocity when equal spaces are described in equal times, and with *variable velocity* when unequal spaces are described in equal times. The former is expressed by $vt = s$, where v denotes the velocity and s the space described in time t.

In the case of variable velocity the average velocity may be obtained by noting the small space δs described in a short interval of time δt. $\therefore v = \frac{\delta s}{\delta t}$.

Equations of Motion.—Elementary proofs of the so-called equations of motion may be obtained from any text-book on the subject. Thus, if V denotes initial velocity, and a uniform acceleration, then, with the usual notation,

$$v = V + at \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (i)$$

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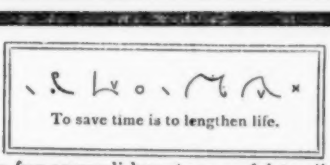

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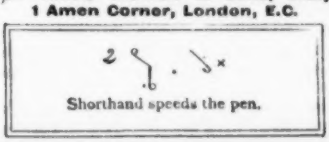

Shorthand speeds the pen.

$$\therefore s = \tfrac{1}{2}(V + V + at)t = Vt + \tfrac{1}{2}at^2 \quad . \quad . \quad . \quad \text{(ii)}$$

Eliminating t from (i) and (ii), we obtain

$$v^2 = V^2 + 2as \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(iii)}$$

In each of the preceding cases it has been assumed that a is positive. If a is negative, it is only necessary to replace the positive by a negative sign, or the two cases may be combined by using the double sign—that is,

$$v = V \pm at \text{ (1)}, \quad s = Vt \pm \tfrac{1}{2}at^2 \text{ (2)}, \quad v^2 = V^2 \pm 2as \text{ (3)}.$$

If the body starts from rest, the initial velocity is zero, and the preceding equations become

$$v = at, \quad s = \tfrac{1}{2}at^2, \quad v^2 = 2as.$$

In the case of falling bodies, a has a particular and definite value, denoted by g (the acceleration due to gravity), and it is only necessary to replace a in each of the preceding equations by g.

Using the simple notation of the calculus, we should write $\frac{d^2s}{dt^2} = a$. Integrating, we obtain $\frac{ds}{dt}$ or $v = at + C$, where C is a constant of integration. If v is 0 when t is 0, then $C = 0$. $\therefore v = at$.

Again integrating, $s = \frac{1}{2}at^2 + C$, and if when t is 0, s is 0, then $C = 0$. $\therefore s = \frac{1}{2}at^2$. If, however, when t is 0, $v = V$, then $C = V$, and the preceding equations become $v = V \pm at$ and $s = Vt \pm \frac{1}{2}at^2$ respectively.

Angular Velocity.—When a body is moving in a circle of radius r, with uniform velocity v, if n denotes the number of revolutions per second, then the angle described in one revolution is 2π, and in n revolutions is $2\pi n$.

$$\text{Hence } w = 2\pi n, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(iv)}$$

where w denotes the angular velocity of the *rotating body*. The linear velocity is obviously $2\pi nr$.

If t is the time required for one revolution, or *the periodic time*, then $nt = 1$, and (iv) becomes $w = \frac{2\pi}{t}$, ... (v)

where, as in (iv), the symbol w indicates the number of unit angles, or *radians*, per second.

Ex. 1. What is implied in the rule: The product of the diameter of a wheel in feet, and of the revolutions per minute, divided by 28, is the speed in miles per hour?

Also in the rule: Three times the number of telegraph posts per minute is the speed in miles per hour?

(Inter. Science, 1903.)

If the diameter is denoted by d, then the distance moved through in one revolution is πd, and is $n\pi d$ feet per minute, where n denotes the number of revolutions per minute. Hence the distance moved through in one hour will be $n\pi d \times 60$ feet.

$$\therefore \text{speed in miles per hour} = \frac{n\pi d \times 60}{5280}.$$

$$\text{Taking } \pi = \frac{22}{7}, \text{ this becomes } \frac{nd \times 60 \times 22}{5280 \times 7} = nd \div 28.$$

The second rule may be verified in a similar manner.

Ex. 2. Compare linear and angular velocity in the case of uniform motion in a circle.

Find the angular velocities—(*a*) of the hour hand of a clock; (*b*) of a carriage wheel, 3 feet in diameter, moving at 8 miles per hour. (1903.)

(*a*) From (v), $w = \frac{2\pi}{60 \times 60} = \frac{\pi}{1800}$ radians per second.

(*b*) Assuming that no slipping of the wheels takes place, then the distance moved by the wheel in one second is πdn, where d is the diameter of the wheel in feet, and n the number of revolutions per second.

$$\text{Also 8 miles per hour} = \frac{8 \times 5280}{60 \times 60} \text{ feet per second.}$$

$$\therefore \pi dn = \frac{8 \times 5280}{60 \times 60},$$

$$\text{or } n = \frac{8 \times 5280}{60 \times 60 \times 3 \times \pi},$$

$$\text{and } w = 2\pi n = \frac{2\pi \times 8 \times 5280}{60 \times 60 \times 3\pi}$$

$$= 7{\cdot}823 \text{ radians per second.}$$

Ex. 3. If a body be moving with constant acceleration, show that the magnitude of the acceleration may be determined by timing its passages over two consecutive equal portions of its path. Give a formula.

Telegraph-posts being 80 feet apart, the times taken by a train in passing consecutive intervals between the posts are found to be five and four seconds respectively. Prove that the acceleration is numerically $8 \div 9$. (1903.)

Ex. 4. Express the normal component of the linear acceleration of a point moving in a circle, in terms of the angular velocity and the radius.

If the point describes 20° of arc in a minute, what is the average angular velocity? (1903.)

Ex. 5. Define "angular velocity." What is the "unit" of angular velocity?

A point P is moving along a plane curve with velocity v. At a certain instant the point and the tangent to the curve through it are at distances r, p respectively from a fixed point O. What is then its angular velocity about O? (1902.)

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The Artificial Production of Light.—Generally speaking, matter becomes self-luminous, or emits light, when its temperature is sufficiently raised. The reason of this is sufficiently obvious. When the temperature of a body is raised, its constituent molecules are set in rapid motion, the higher the temperature the greater being the kinetic energy of each molecule. If the substance is in the solid state, its molecules are very closely packed, so that progressive motion is impossible. Each molecule is forced, by reason of collision with its neighbours, to practically vibrate about a fixed position, its period of vibration becoming less as the temperature is raised. Experiment shows that a large body, moving with any ordinary velocity, does not disturb the ether through which it passes. On the other hand, the rapid motion of a molecule sets the surrounding ether in motion, with the result that a wave disturbance spreads from it through the ether. If the wave-length of this disturbance lies within certain limits (between about 0·008 mm. and 0·004 mm.), the ethereal disturbance is capable of affecting the eye, and is termed light. It is fairly obvious that in general the radiations emitted by a heated solid will not be restricted to any particular wave-length. Different molecules will be moving with different velocities, and will thus possess different vibration frequencies. At a given temperature the average velocity of the constituent molecules will possess a definite value, but some molecules will be moving with a greater, and some with a smaller, velocity; the number of molecules moving with any particular velocity becoming smaller and smaller, according as the velocity in question differs from the average (or normal) velocity corresponding to the given temperature. Thus we may expect that a heated solid will emit waves of lengths varying continuously between wide limits. Most of the energy radiated will correspond to waves whose lengths lie very close to a certain value; while waves of which the lengths differ greatly from this value will carry away very little energy. Expressed differently, we may say that a curve, drawn with wave-lengths as abscissæ, and energy as ordinates, will slope upwards to a fairly definite maximum, after which it will decline and ultimately approach the axis. The peak or maximum point of this curve will correspond to the energy radiated by the molecules vibrating with the frequency normal to the given temperature; and since an increase of temperature will diminish the normal vibration period of the molecules, it follows that the higher the temperature the more will the peak of the curve be shifted toward the short wave-length end of the curve.

Now, for a body to be self-luminous, it is not alone sufficient that a great deal of energy should be radiated; the luminosity will depend on the energy radiated by waves *of which the lengths lie between about 0·004 and 0·008 mm.* At a low temperature much energy may be radiated, but it will correspond almost exclusively to long wave-lengths; for the light to be produced, the peak of the energy-curve must correspond to some wave-length lying between 0·004 mm. and 0·008 mm., or at least the peak must correspond to a wave-length not much greater than 0·008 mm. The peak of the energy-curve of sunlight corresponds to a wave-length of about 0·006 mm. As we cannot obtain any source of heat at a temperature so high as the sun, it follows that the peaks of energy-curves for artificial sources of light will correspond to wave-lengths greater than that of sunlight; and this will mean that artificial sources of light will be comparatively poor in short wave-lengths, and rich in long wave-lengths incapable of affecting the eye. The peak of the energy-curve of the electric arc light corresponds to a wave-length of about 0·012 mm.; while that of gaslight corresponds to a wave-length of about 0·017 mm. In both of these cases the waves which are radiated in the greatest abundance are much

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too long to affect the eye as light, and consequently most of the energy radiated is wasted, so far as the production of light is concerned. It will easily be understood that a source of light is efficient according as the peak of its energy-curve corresponds to a wave-length approximating to 0·006 mm. The following fundamental laws will now, it is hoped, be easily grasped :—

1. *For a heated body to emit light, the peak of the energy-curve must correspond to a wave-length not very much greater than 0·008 mm. The greater the wave-length corresponding to the peak of the curve, the dimmer and the more reddish will be the light emitted.*

2. *For heat to be converted at a high efficiency into light, the peak of the energy-curve must correspond to a wave-length as near as possible to 0·006 mm. As a result, the temperature of the radiating body must be raised as nearly as possible to that of the sun.*

The temperature of the sun is probably between 4,000° C. and 7,000° C. It must be remembered, in connection with the above, that the only radiations at present contemplated are those depending merely on the temperature of the source. Many methods of producing light involve some little-understood chemical changes, and to such cases the above reasoning does not apply. A poker heated in the fire emits red light at a low temperature, and the emitted light approximates more and more closely to white light as the temperature is raised. This is a case to which the above reasoning applies, since any chemical reaction which occurs is not material to the production of light. Similarly, a piece of platinum wire becomes incandescent, or glows and emits light, when its temperature is sufficiently raised. In this case there is absolutely no chemical action. The luminosity of a gas flame is due to the high temperature to which fine particles of carbon are raised. When a piece of cold glass is placed in such a flame, some of the carbon becomes condensed on the glass. If the supply of air to the flame is increased, as in the case of a Bunsen burner, the carbon particles are not formed, and the flame becomes scarcely luminous.

Generally speaking, a black body emits radiations more freely than a white or a transparent body; for the reasons of this the student may consult the author's *Heat for Advanced Students*.

The Electric Glow Lamp.—As already stated, a piece of platinum wire, when raised to a sufficiently high temperature (as, for instance, by passing through it an electric current), emits luminous radiations, or produces light. Platinum is not, however, the best substance to use. In the first instance, it is a very costly substance, being now, weight for weight, dearer than gold; and in the second instance, since it is not black, it will not emit the greatest possible amount of light at a given temperature. Carbon is a black substance, and can be fairly cheaply produced. If a carbon filament is heated by an electric current, under such conditions that it cannot burn, it will continuously produce light under favourable conditions. To prevent the filament from burning, it might be placed in a closed vessel filled with pure hydrogen or nitrogen; but in this case the gas surrounding the filament would carry the heat away from it by conduction and convection, and thus reduce its temperature, or, what amounts to the same thing, necessitate the expenditure of a greater amount of electrical energy in order to raise it to such a temperature that it becomes incandescent. In practice, therefore, the filament is enclosed in an air-tight glass globe from which all gas has been carefully exhausted. The filament is formed from pure cotton wool dissolved in a solution of zinc chloride, which forms a substance of the consistency of treacle. This substance is squirted through a small circular orifice in the form of a thread, which hardens when passed through water to dissolve out the zinc chloride. The filament, which now looks like catgut, is next wound on a carbon-former in order to give it the shape required for the lamp, and is then placed in a crucible, surrounded by powdered charcoal, and raised to a bright red heat. In this process the volatile substances in the filament are driven off, the filament itself being reduced to nearly pure carbon. It is unable to burn, since oxygen, in order to reach it, would have to pass through the surrounding red-hot charcoal, and would cause the latter to burn, producing carbon monoxide, which cannot support combustion. The filament is then allowed to cool, after which it is removed from the crucible, and small platinum wires are pinched on to its ends. The filament is then placed beneath benzine, and an electric current is passed across each junction between it and the platinum wires. The junction becomes white hot, the benzine is decomposed, and carbon is deposited at the junction, thus making a good electrical connection. The filament is then placed in the glass globe which is to contain it, and the two platinum wires are sealed into the walls of the bulb by the aid of a blowpipe flame. Platinum is used for this purpose, since its coefficient of expansion is very nearly equal to that of glass, thus ensuring that the joint shall not crack during cooling. The bulb is then carefully exhausted, first by a mechanical pump and then by a mercury pump. Finally, an electric current is passed through the filament so as to raise it to a higher temperature than will be subsequently used, and all gaseous matter expelled from the filament is then removed by the pump. After this the bulb is sealed off by the aid of a blowpipe flame, and the construction of the lamp is practically completed.

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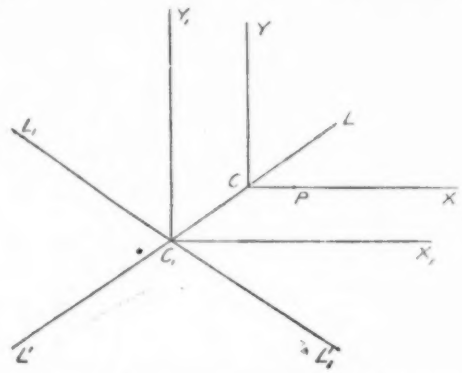
(*Continued from page 206.*)

Quex.—A series of hyperbolas have a common asymptote, and their other asymptotes are parallel. They also all pass through a given point. Show that their vertices lie on two fixed parabolas.



Let LL′ be the common asymptote, and let $L_1L'_1$, any one of the series of parallel asymptotes, intersect LL′ in C_1. Let C_1X_1, C_1Y_1 bisect the angles $LC_1L'_1$, LC_1L_1, and let $\tan^{-1}m$ measure the angle LC_1X_1. Let P be the given point of intersection of the series of hyperbolas, and let x_1, y_1 be the co-ordinates of P referred to C_1X_1, C_1Y_1 as axes. Through P draw PC parallel to C_1X_1, and meeting LL′ in C.

The hyperbola, whose centre is C_1, has its asymptotes given by the equations $y - mx = 0$, and $y + mx = 0$; hence the equation of the hyperbola is

$$(y - mx)(y + mx) = \text{a constant}. \quad . \quad . \quad . \quad (1)$$

(See Loney's *Co-ordinate Geometry*, § 326.)

But the hyperbola passes through the point x_1, y_1, hence the constant in (1) is equal to $y_1^2 - m^2x_1^2$, and (1) may be written

$$y^2 - m^2x^2 = y_1^2 - m^2x_1^2. \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Let x, y be the vertex of (2); then $y = 0$, . . . (3)

and x is determined by the equation $m^2x^2 = m^2x_1^2 - y_1^2$. (4)

Transform (3) and (4) to parallel axes through C. Then (3) becomes $y = -y_1$, and (4) becomes

$$m^2\left(x + \frac{y_1}{m}\right)^2 = m^2x_1^2 - y_1^2. \quad . \quad . \quad . \quad (5)$$

Hence, expanding and writing $-y$ for y_1, we see that the co-ordinates of the vertex referred to parallel axes through C must satisfy the equation

$$m^2x^2 - 2mxy + y^2 = m^2x_1^2 - y^2. \quad . \quad . \quad . \quad (6)$$

Now, if x_2, 0 be the co-ordinates of P referred to the new axes through C, then $x_1 = x_2 + \frac{y_1}{m} = x_2 - \frac{y}{m}$. Hence (6) may be written $m^2x^2 - 2mxy + y^2 = m^2\left(x_2 - \frac{y}{m}\right)^2 - y^2$,

and this reduces to

$$(mx - y)^2 + 2mx_2y - m^2x_2^2 = 0. \quad . \quad . \quad . \quad (7)$$

But (7) is the equation of a fixed parabola. Hence the vertices of all those branches of the given series of hyperbolas which pass through the given point P lie on a fixed parabola.

Now, in any standard work on conic sections, it is shown that the other branches of the given series of hyperbolas all pass through another fixed point. (See Salmon's *Conic Sections*, § 255.) Hence the vertices of all these branches will lie on another fixed parabola.

Therefore, if the given series of hyperbolas all pass through a given point, their vertices lie on two fixed parabolas.

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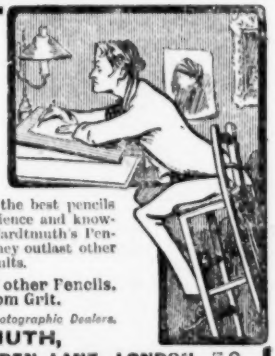

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